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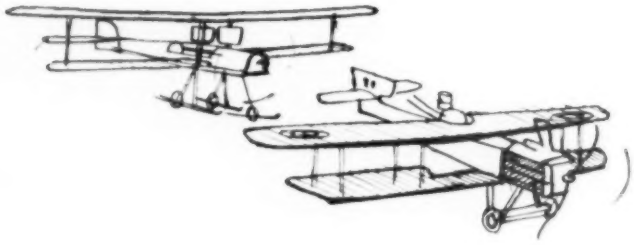

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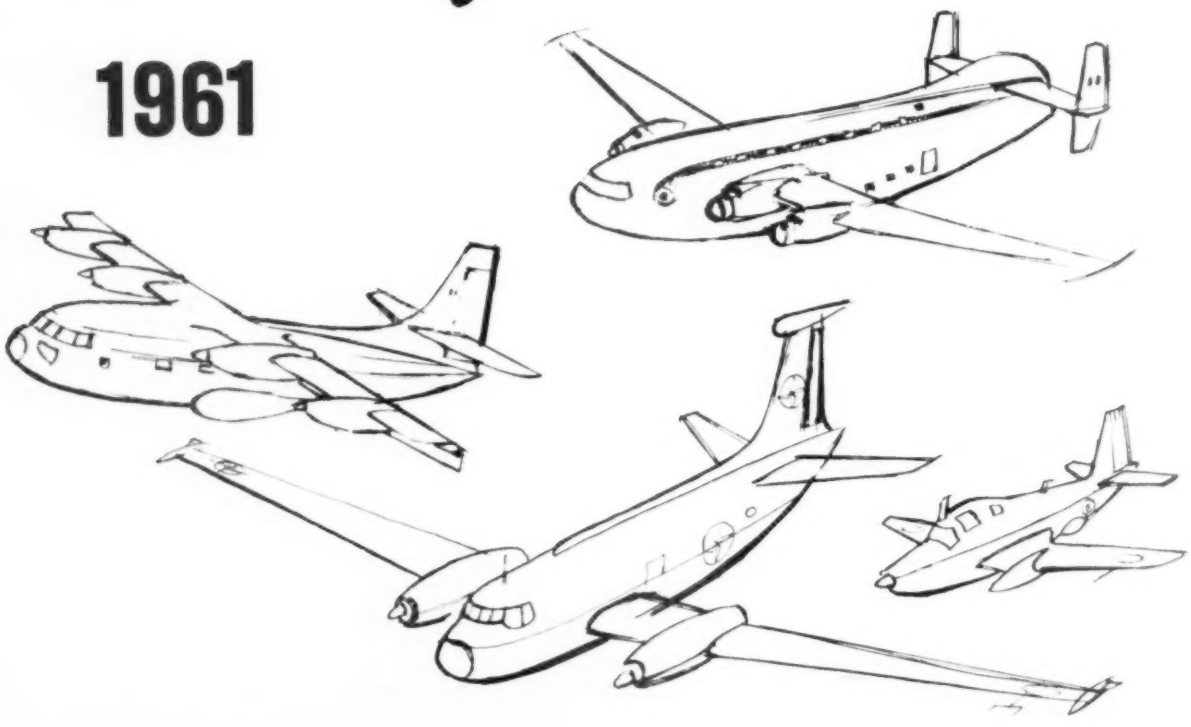

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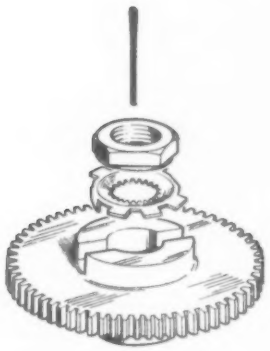

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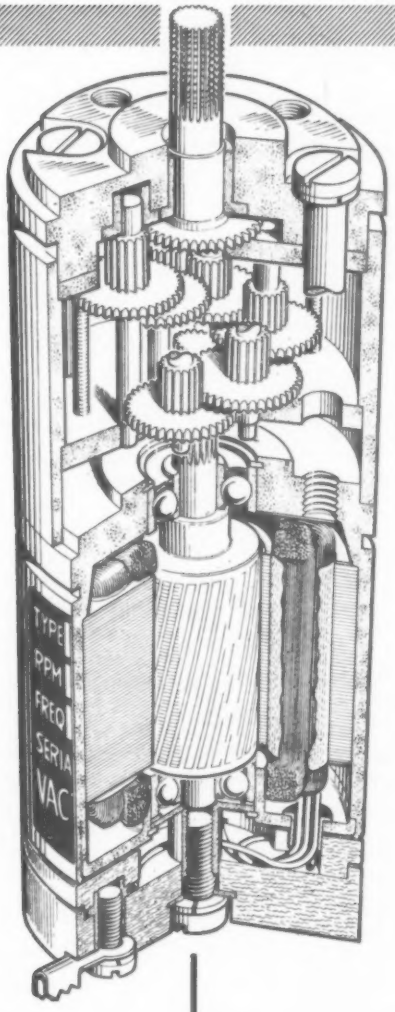

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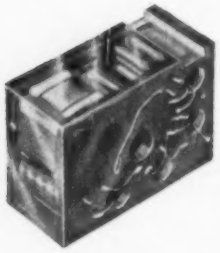

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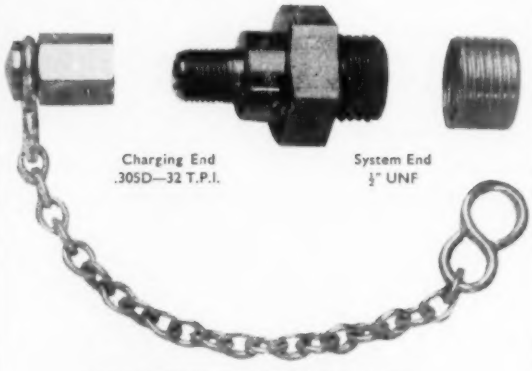

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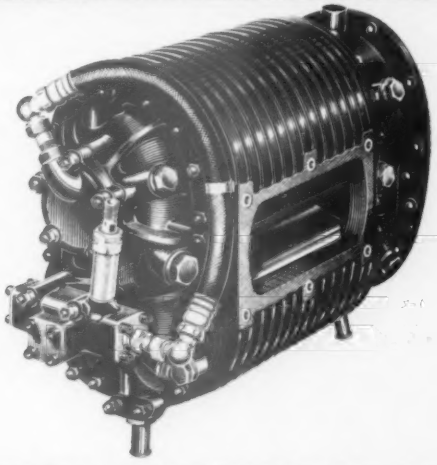

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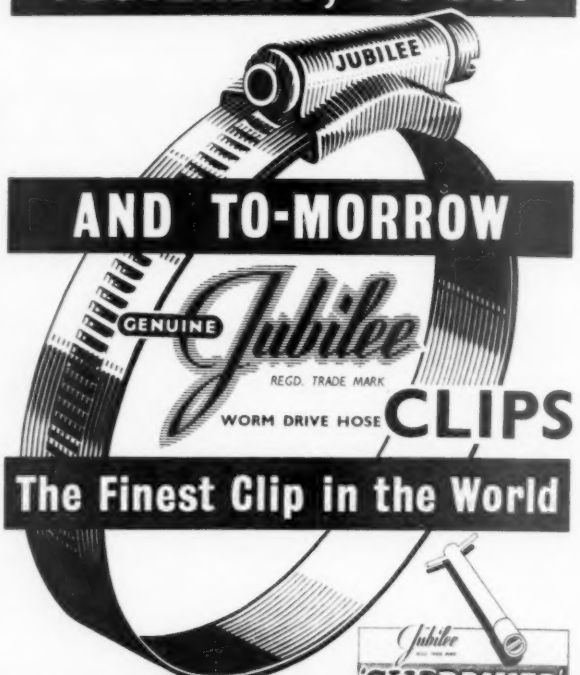

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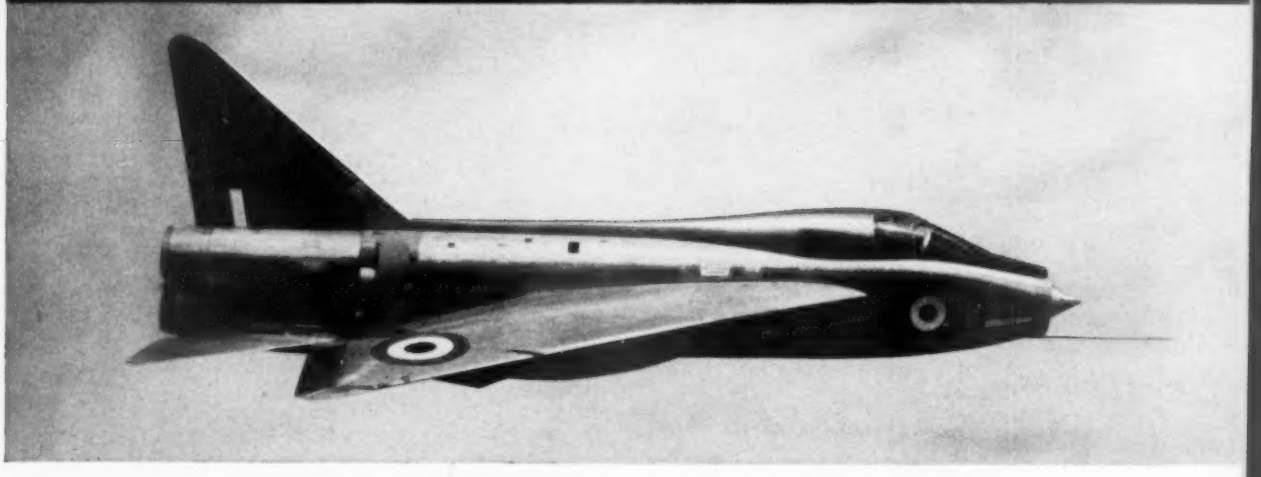

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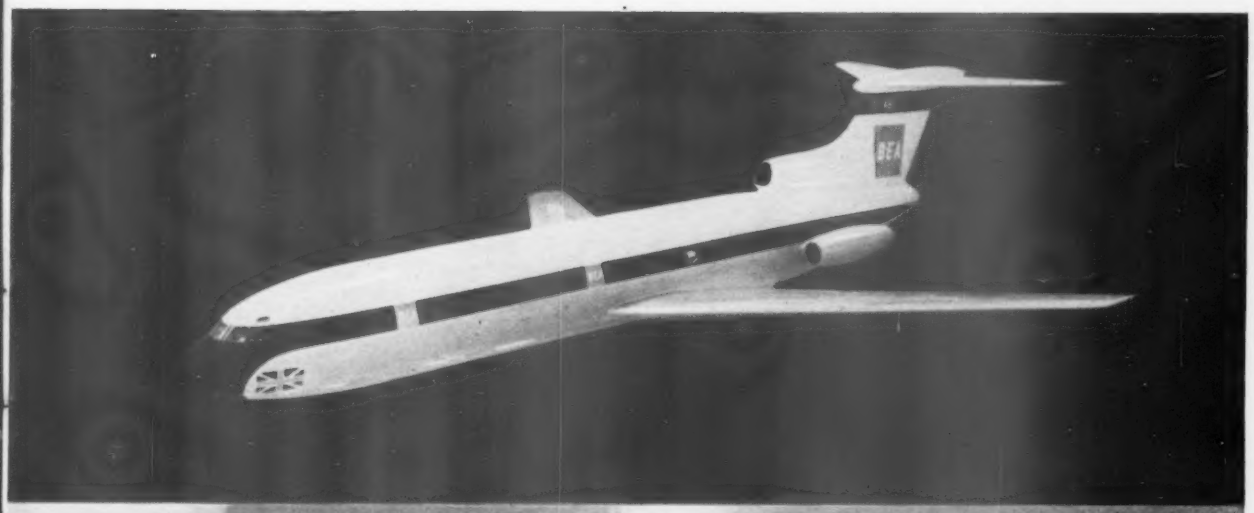

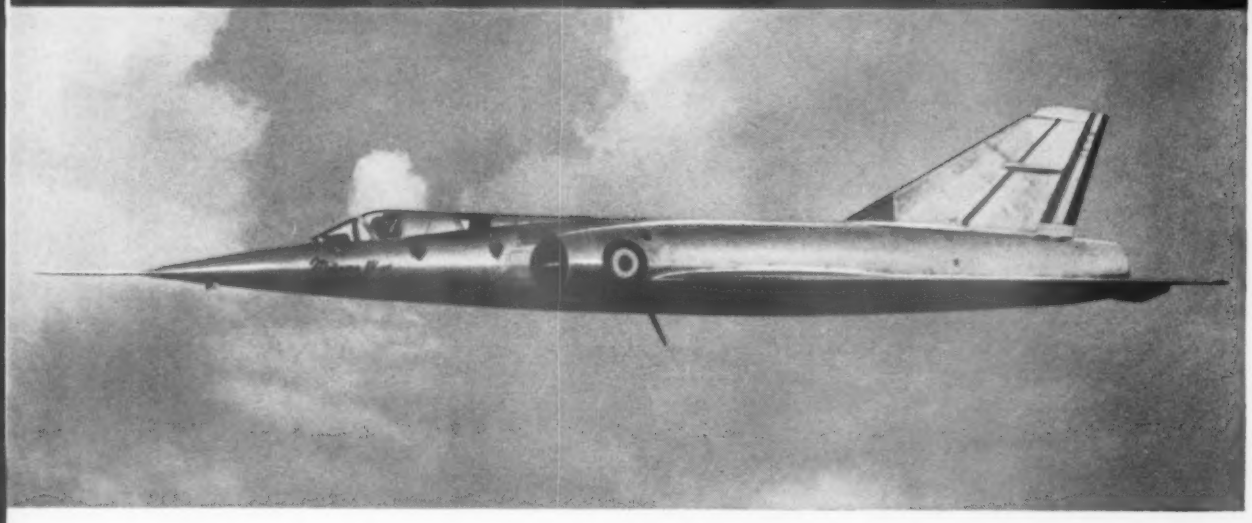

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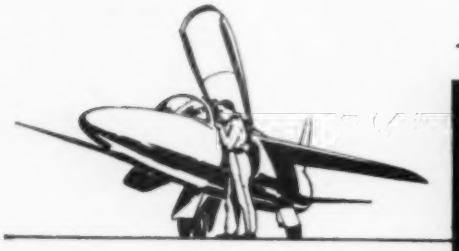

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To train a pupil by a two-stage system from the *ab initio* stage to operational standard costs nearly £73,000. By a three-stage sequence not only is the training better balanced and safer but the cost is considerably less—£44,200—a saving of over £28,000 per pupil.

The capital cost of the aircraft required for an output of 124 operational pilots a year is £63½ million for two-stage training, but under £35 million for three-stage training—a saving of £28½ million—the cost of 70 front line fighters!

The saving in cost is largely the result of the high utilisation factor of the Gnat which, at 35 flying hours per month, is more than twice that of the training version of the operational bomber or fighter. This high utilisation factor of the Gnat not only reduces capital and operating costs but enables substantial economies to be made in servicing manpower.

These figures are based on the system used by Air Ministry for determining costs and include fuel, oil, spare parts, replacement of wastage and 3rd and 4th line maintenance at contractors.

THREE STAGE		TWO STAGE
BASIC JET TRAINER 160 HRS x £48/HR £7,680 160 HRS		BASIC JET TRAINER 160 HRS x £48/HR £7,680 160 HRS
GNAT ADVANCED TRAINER 160 HRS x £72/HR £11,520 320 HRS		OPERATIONAL BOMBER OR FIGHTER 260 HRS x £250/HR £65,000 420 HRS
OPERATIONAL BOMBER OR FIGHTER 100 HRS x £250/HR £25,000 420 HRS		
OPERATIONAL STANDARD £44,200		OPERATIONAL STANDARD £72,680

HAWKER SIDDELEY AVIATION 32 Duke Street, St. James's, London, S.W.1

THE AEROPLANE and ASTRONAUTICS

VOLUME 100 NUMBER 2587 MAY 18, 1961

Expanding Collaboration

A special feature in this issue has been devoted to the aircraft industries of Western Europe. It is therefore particularly fitting that we should be able in the same issue to report the far-reaching agreement concluded between the Hawker Siddeley Group on the one hand and the Otto Wolff Group on the other. So far as aviation is concerned the agreement is in the nature of further strengthening an existing link in that Otto Wolff has represented Hawker Siddeley aircraft interests in Germany for some time. It will be recalled that Hawker Siddeley also have close links with the French aircraft and rocket industry. German interest in the Hawker P.1127 following the NATO requirement, not yet finalized, for a VTOL fighter has already been expressed.

So far as the European industry itself is concerned co-operation has gone a long way. In this issue we deal at length with the plans for the integrated production of the Lockheed F104-G. This will involve collaboration on the widest scale. It is germane to the subject of this issue that the Lockheed company in efforts to get the R.A.F. interested in an STOL version of the Hercules transport have reached an understanding with the other British aircraft group, B.A.C., for the building, if ordered by the United Kingdom, of the Hercules by B.A.C.

Two other specially interesting combined undertakings are the Breguet Atlantic and the Transall C-160. Both are dealt with in some detail in the following pages. These are of special interest to British industry in view of the quantity of British equipment used.

We must all regret that so far the steps taken to undertake astronautical work in collaboration are on a much more restricted scale.

However, the more closely the aircraft industries of Europe get integrated, the more complex will become the problem to which Sir Reginald Verdon Smith devoted attention in his annual report on the Bristol Aeroplane Company. Having in mind the special relationship between the British aircraft industry and the Government, which is, in effect, a partnership, Sir Reginald emphasized that policy making must be positive and constructive; the implementation of decisions must be firm and brisk. In view of the developments outlined in this issue nobody can be satisfied with a situation where many people in the aircraft industry in the United Kingdom feel that the Government depends too much on waiting to see what is going to be done in other countries. The natural outcome of such a policy must have the frustrating result that the machinery moves too slowly and by unnecessarily small stages.

Dinghy Sailors of the Air

By way of contrast to the problems of aircraft production and airline operation which occupy so much of the efforts of his industry, it was good to see that Mr. Peter Thorneycroft was able to get down to Lasham last Saturday to open the National Gliding Championships. In the short trip he was able to make in the London Club's famous two-seater he would hardly have time to probe deeply the aspects of air traffic control which cause the British Gliding Association so much concern. But at least the trip should have given him the opportunity to savour for himself the peculiar pleasures and responsibilities of motorless flight.

Editor - - - - THURSTAN JAMES
Deputy Editor - - - - F. T. MEACOCK

Founder Editor (1911-1939) *C. G. Grey*

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Matters of Moment

Too Many Restraints

ALL the recent changes in the aircraft industry's structure have brought "a new sense of purpose and of opportunity." This encouraging thought has been expressed by Sir Reginald Verdon Smith, chairman of the Bristol Aeroplane Company in his annual report published last week. Looking to the future he comments that there is one respect, at least, in which prospects for the aircraft industry depend upon different and unusual considerations: "The nature of our business," he says, "means that, irrespective of politics, the industry and the Government are in partnership.

"With that special relationship it is of very great importance to the country that the making of policy should be positive and constructive, and that the implementation of decisions should be firm and brisk. There can be no doubt that the possibilities lying ahead of this generation in the whole field of aviation and astronautics are immense: it is also clear that they are of such strategic and economic significance that the general course of their development is today, even more than in the past, a national responsibility. . . .

"There is no escape from the difficulties or the risks inherent in aviation: whether the immediate question concerns the equipment or the operations of civil air transport in its international setting, or the pattern of defence policy and the selection of appropriate weapons, the rapid development of the several technologies which converge upon aviation imposes a great challenge upon those with whom lies the responsibility for decision. The expectation that scientific development will shortly bring further swift change can all too easily lead to uncertainty in policy and consequent delay in arriving at specific requirements.

"The problems are admittedly complex: nevertheless now that so much has been done to consolidate the country's industrial resources it is no less important that the administrative machinery upon which stable and consistent planning depends should not creak, and that there should be no lack of initiative in the places where responsibility lies. . . .

"If one asks almost anyone in the industry who is familiar with the administrative process whether he is satisfied with its operation at present he will very likely reply that today more than ever before we depend too much on waiting to see what others in other countries will do, and that thereafter the machinery moves too slowly and by unnecessarily small stages. No one will dispute the need to exercise strict economy in the spending of public funds but there is reason to feel that the restraints and scrutinies being applied at the present time are making it harder to keep abreast of competition from elsewhere and unnecessarily difficult to keep the advantage where we happen to have gained a technical lead."

Subject to these reservations, Sir Reginald concludes, the general prospects of the aircraft industry can be viewed with much greater confidence today than was the case two or three years ago.

SAFETY PRESENTATION.—Mr. E. S. Calvert (right) receives the Monsanto Aviation Safety Award from Mr. Robert M. Morris vice-president of the Monsanto Chemical Company. Centre is Mr. E. R. Quesada former administrator of the F.A.A.

Commercial Interests in Space

PRESSURE from private industry to allow Britain to go ahead with a programme for the commercial exploitation of space is gathering momentum. It may, in fact, cause the Government to reconsider its policy regarding the 12-nation plan to develop a European heavy satellite launcher based on Blue Streak, and start on the project alone, or possibly in collaboration with France.

One of the principal exponents of this move is Sir Robert Renwick, chairman of the newly-formed British Space Development Company. Speaking to the Radar and Electronics Association on May 12, he said:

"The Minister of Aviation inherited a policy of a British and Commonwealth space programme—provided France and Germany came in too. Over the months he has worked very hard and up to a few days ago it appeared that he was going to be successful and would be able, within a few weeks, to announce a British European programme.

"Four days ago, however, Mr. Dean Rusk, U.S. Secretary of State—with perfect timing—offered to put American rockets and satellites at the disposal of Western Europe—an offer which our European friends may find it hard to refuse.

"It would seem clear to me that the Americans are determined to keep Britain out of commercial space by all means in their power." He said the Americans were "shrewd businessmen and know there is money to be made on communication satellites because technically it will put their industries well in advance of European industries and so boost their exports throughout the World."

CHAMPIONSHIP SCENE.—An air-to-ground shot of the activities at Lasham last week-end during the opening phases of National Gliding Championship there.

Photograph copyright "The Aeroplane and Astronautics"

Gliding Championships Begin

HAVING opened the 1961 National Gliding Championships at Lasham, Hants, on May 13, Mr. Peter Thorneycroft, the Minister of Aviation, went up in a glider for the first time in his life, and wanted to do it again. This was, as he said, the largest gliding contest ever held, with 90 sailplanes and 129 pilots. Another record was for the number of R.A.F. entries (see p. 522 last week).

At 13.30 hrs. the same day, launches began for a race round a 64-mile triangle via Thruxton and Welford for the 50 entrants in League I. Only John Williamson, in an R.A.F. Olympia 419, finished the course, taking from 14.22 to 18.15 B.S.T. Next best were Wally Kahn and Philip Wills, who shared Williamson's last thermal but one and then sank to earth. The first leg was the worst, with weak thermals stopping short of 3,000 ft. and a contrary 10-knot wind. It brought down four-fifths of the competitors short of Thruxton, and the rest averaged between 5 and 10 m.p.h. getting there.

Sunday's task for both leagues was maximum distance, starting with a 30-mile flight N. by W. to Benson against a 15-knot N.W. wind, and anyone who got that far could proceed from there in any direction he liked. This time there were cumulus clouds, which had been absent the day before.

From Benson one group, including Philip Wills and Peter Scott, set off northwards, lured by meteorological promises, but were baulked by an unexpected "clamp" from the N.E. Many

turned south for the Channel coast and of these Tony Deane-Drummond got to Hythe and Ted Stark and John Williamson to Rye. Only two turned west, but they became the day's winners in each league, Roger Mann of League I making 165 miles to Torquay and David Kerridge, of League II, 75 miles to Salisbury.

In overall points Williamson is leading with 1,047, followed by Mann with 1,000, D. Jones 869, Deane-Drummond 795 and Stark 739.—A.E.S.

Honoured by the R.Ae.S.

IT was welcome news indeed to learn last week from the Royal Aeronautical Society that Sir Sydney Camm, C.B.E., F.R.Ae.S., and Mr. J. D. North had been selected by the Council to be made Honorary Fellows of the Society. This—the highest honour the R.Ae.S. can bestow—pays just tribute to the invaluable contributions that these two eminent aeronautical engineers have made to the development of the aeronautical sciences over the years.

Sir Sydney Camm, who is director and chief engineer of Hawker Aircraft, has already been the recipient of high R.Ae.S. honours for in 1949 he was awarded the British Gold Medal and less than 10 years later received the Society's Gold Medal. He has spent a lifetime in aeronautical engineering; having joined the Hawker Engineering Company in 1923 he became its chief designer in 1925. In the years which followed he has been responsible for many notable—and elegant—aeroplanes among which the Hurricane will long be remembered as a potent factor in the R.A.F.'s success in the Battle of Britain. His latest is Britain's first VTOL aircraft designed from the outset as a military operational type. Sir Sydney was president of the Royal Aeronautical Society in 1954-55.

Mr. J. D. North, who is chairman and managing director of Boulton Paul Aircraft, Ltd., started his career as an aeronautical engineer before the 1914-18 War when he became chief engineer to the Grahame-White Aviation Company at Hendon. He

Photographs copyright "The Aeroplane and Astronautics"

BIGGEST YET.—The National Gliding Championships at Lasham were opened by Mr. Peter Thorneycroft, Minister of Aviation, on May 13, who went for a trip in "Daisy" (left). Upper, the Bocian of the Polish A.F.A. and, lower, Andy Gough takes off in the new Elliott 460.

joined Boulton and Paul—as the company was then known—in 1917 and has been with it ever since. He is an active member of the Air Registration Board, a Member of Council of the S.B.A.C. and a member of the board of governors of the College of Aeronautics.

Fifty Years a Flying Instructor

AT his seventieth birthday party at Shoreham last week-end Mr. Cecil Pashley, M.B.E., A.F.C., who is still flying professionally as an instructor after 50 years of work at the job, was told by Capt. O. P. Jones, representing the Master of the Guild of Air Pilots and Air Navigators, that he is to receive the Guild's Award of Merit. The Award of Merit was established in 1958 and is conferred on Freemen of the Guild for meritorious service as air pilot or air navigator in any sphere of British aviation. It carries with it a silver medal.

Cecil L. Pashley began glider flying in 1908, and in 1911 he founded the flying school at Shoreham, where he still trains pilots. He instructed on an enormous variety of aircraft types during the two World Wars and has logged more than 18,300 hours. The Guild recognizes that his services in flying instruction—he has taught about 1,600 students to fly—have made an outstanding contribution to the development of aviation, and the defence of Great Britain and the Commonwealth.

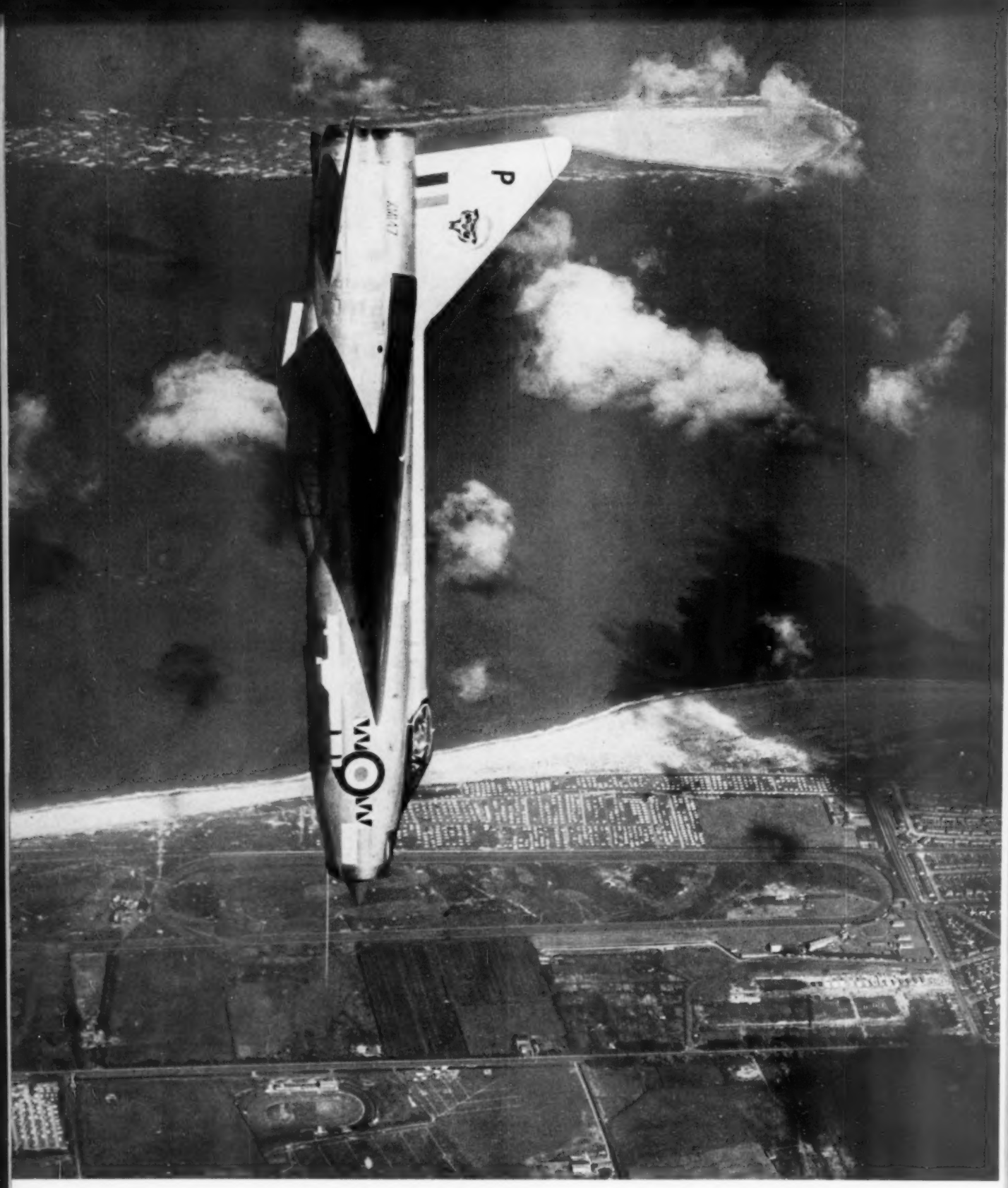
In the opinion of many the fact that "Pash" has never been engaged on airline or charter flying must mean that his total of hours flown covers more take-offs and landings than have been made by any other person. His record averages better than one hour's flying for every day of 50 years.

Licence-built Hercules Offered to the R.A.F.

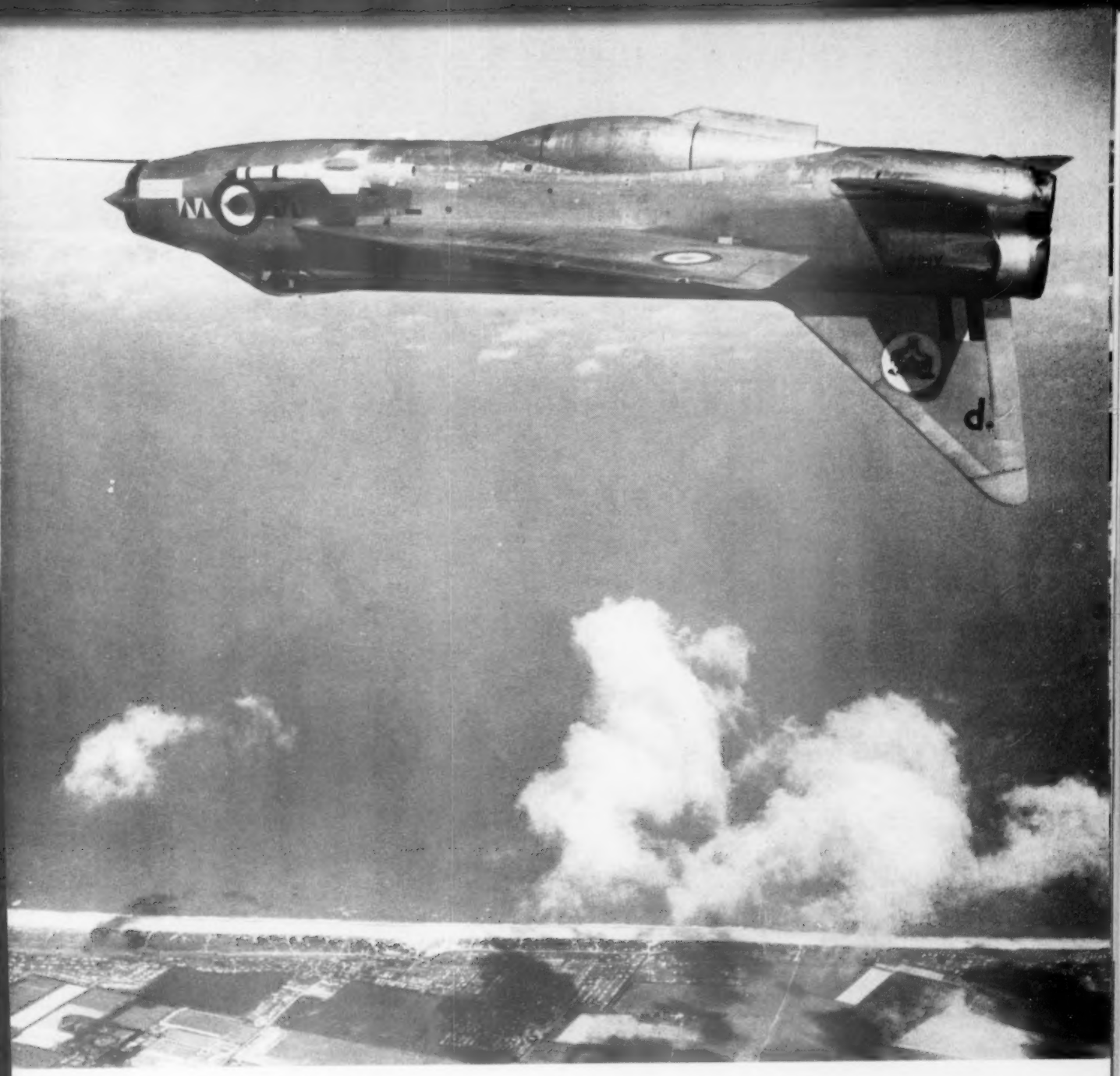
LOCKHEED are making considerable efforts to sell a STOL version of their C-130 Hercules military transport to European countries. In Britain they have an understanding with the British Aircraft Corporation that B.A.C. should produce the aircraft under licence if it is ordered for the R.A.F.

To quote a recent advertisement in *The Economist*, "Lockheed is prepared to support a licensed manufacturing programme in the U.K. to produce a Rolls-Royce-engined STOL Hercules to British requirements." It is claimed that the blown-flap BLC system of this aircraft would allow it to operate from 500-ft. unprepared surfaces.

As STOL fighters and strike aircraft come into service there will be a requirement for STOL transports to support their operations. To meet such a requirement, B.A.C. are unlikely to have put all their eggs into the Lockheed basket; they and probably other companies must have indigenous similar projects.



IN SERVICE HANDS.—No. 74 Squadron R.A.F. (motto "I Fear No Man"), recently equipped with English Electric Lightning F.Mk.Is (two 14,430-lb.s.t. Rolls-Royce RA.24R Avons), is to give a display of formation flying during the Paris Aero Show. In these pictures the C.O. of the Squadron, Sqn. Ldr. J. F. G. Howe, shows off the handling qualities of the R.A.F.'s supersonic all-weather fighter whether inverted during a roll or diving vertically alongside the A.W. Meteor NF.14 photographic aircraft carrying our photographer Alfred Long.



The R.A.F. Today

ONE of the year's major functions, the Pathfinders' Reunion Dinner, can be counted on to have an impressive, brass-bound top table that will speak informatively and entertainingly.

At this year's dinner, on May 8, AIR MARSHAL SIR KENNETH CROSS, A.O.C.-in-C., Bomber Command, revealed something of his mobile Command's offensive potential and the spirit and capability of its personnel. Most impressive, even frightening, was his statement that Bomber Command's hitting power was now the equivalent of that of *29 million* Lancasters. He added, possibly with intent, that he still had more aircraft than the two airline corporations put together, although we were left to guess whether this included the remaining 50 Canberras which he said the Command would soon be dispensing with.

Of their missiles, he said that whereas a combat aircraft can take eight or more years to progress from drawing board to operational force, Thor had done it in 4½ years. It was an efficient weapon and with some 4,000 trained men to operate it, the Command had the only qualified I.R.B.M. force on this side of the Atlantic.

Turning to the vital question of aircrew, Sir Kenneth said that although the rigorous standards of selection and training eliminated approximately 69 out of every 70 starters and so made it difficult to maintain the numbers, the calibre of the crews who finally emerged could be judged from the results of the recent bombing competition when 96% of their bombs fell in the target area. Results improved all the time—using the same assessment scheme, the team which won the competition in 1957 would have been 47th this year.

The spirit of this Force was akin to that of the war-time Pathfinder Force. Its members, less than 10% of whom are National Servicemen, were poised for instant action at all times.

Another speaker, AIR MARSHAL R. B. LEES, D.C.A.S., said that it was under the umbrella of Bomber Command that the rest of the R.A.F. went to work. Of Coastal Command he said that its Shackletons, in competition with other Forces, had made 80% of the sightings, 70% of the kills. Transport Command, no longer a Cinderella, had got good aircraft and was getting more and better equipment, including STOL aircraft and helicopters. The Army depended for its mobility on Transport Command, which got them there and supported them.

The Pathfinder Association's president, GP. CAPT. T. G. MAHADDIE, announced that 27 ex-R.N.Z.A.F. members had started a P.F.A. branch in their country and pointed out that Air Cdre. C. A. Turner, representing the R.N.Z.A.F. in this country, was present, as were his opposite numbers, A.V.M. A. M. Murdoch, R.A.A.F., and Air Cdre. D. S. Blaine, R.C.A.F. Since Air Marshal Lees and Peter Swan, who proposed the R.A.F. Toast, are also Australians, May 8 seemed more like Anzac Day than VE-day.—WREN.

Aviation News in General

ANGLO-GERMAN LINK-UP.—The Hawker Siddeley Group and the Otto Wolff Group of Cologne, a large producer of steel in West Germany, have concluded an agreement for a trading association covering "a wide range of products." It is understood that co-operation between the groups on aviation matters will begin at once, but the emphasis at first will be on industrial products. Of particular importance is the agreement on aviation in view of possible links between Britain and Germany in the supply of aircraft and weapons for NATO countries.

B.A.C. DOWN UNDER.—To promote sales in Australasia and also help co-ordinate work by its member companies at Woomera, the British Aircraft Corporation has formed the British Aircraft Corporation (Australia) Pty., Ltd., with headquarters at Sydney, N.S.W. Chairman of the new subsidiary is Sir Daniel McVey; Mr. A. W. Millson is managing director.

HAMBLE OPENING.—Tomorrow, May 19, H.R.H. The Duke of Edinburgh is to open formally the College of Air Training, Hamble. During his visit he is to tour the College buildings, fly in one of its Apaches and address the students.

TWO JET DECADES.—Twenty years ago last Monday the first British aircraft to be powered by a turbojet made its initial flight. On May 15, 1941, from the R.A.F. College, Cranwell, the Gloster E28/39, with Frank Whittle's 850 lb. W.1 turbojet providing the propulsion, took to the air for the first time. This aircraft, serialled W4041, now forms part of the National Aeronautical Collection.

GNOME AGUSTA BELL.—First flight of an Agusta Bell 204B helicopter powered by a de Havilland Gnome free-turbine engine was made on May 10, after only 25 minutes' ground running of the engine.

FLIGHT SIMULATION.—The first of two General Precision Systems flight procedure trainers has been delivered to the College of Air Training, Hamble.

HUSTLING HUSTLER.—A Convair B-58 flew at a sustained speed of 1,302 m.p.h. for 30 minutes early this month, to qualify for the Aero Club de France Bleriot Cup, offered for the first aircraft to fly 2,000 km.p.h. (1,243 m.p.h.) for 30 minutes.

POLISH PYE.—The Polish Government have placed an order with Pye Telecommunications for an instrument landing system for use at Okecia, the Warsaw International Airport. This will be the first ILS installed in Poland.

ARMY MISSILE.—The Blue Water SSM, described on this page, will be demonstrated at the Paris Aero Show.

A POTEZ ORDER.—An example of the Potez 840 turboprop feeder-liner, which made its first flight on April 29, has been ordered by Turboflight Inc., of Chicago. This company, which specializes in marketing business aircraft, has also taken an option on 25; fully equipped price in the U.S. is estimated to be about $500,000.

NEXT WEEK

THE AEROPLANE AND ASTRONAUTICS for May 25 will give a pre-view of the British aircraft industry's exhibits at the 24th Paris Salon and those of Europe and America. This issue will cost the usual 1s. 6d. and is obtainable from all bookstalls and booksellers, or direct from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1.

FLY-BY.—The Russian "automatic interplanetary station," launched from a heavy Sputnik on Feb. 12 on a transfer orbit to Venus, is due to pass within 62,500 miles of the planet between May 19-20, according to predictions made by Russian scientists. Radio communication failed some 15 days after the launching.

DYNA-SOAR SKIS.—Boeing have awarded a $45,000 sub-contract to the Goodyear Tire and Rubber Co. for the development of "wire-brush" landing skis for the Dyna-Soar hypersonic glider. Nose landing gear will take the form of an inverted metal dome instead of a wheel.

BLUE WATER.—On May 16, official details of the English Electric Blue Water SSM were revealed. Developed for the British Army, it is a simple and mobile missile system which meets the NATO requirement for a Corporal replacement. A Blue Water fire unit consists of a computer in a Land-Rover and a missile on a combined launcher and transporter on a standard three-ton lorry. The missile has a solid-propellent motor and inertial guidance. The fire unit can leave the launch area by the time the missile reaches its target.

MORE BLUE STREAKING.—According to the Minister of Aviation, two "fully integrated static firings" of the Blue Streak were made early this month.

SPACE CLAIM.—According to a telegram received in Paris by the Fédération Aéronautique Internationale, the Central Aero Club of the U.S.S.R. are to seek recognition of Major Gagarin's orbital mission in the spacecraft Vostok as a World record. This will involve giving more details of the flight, including the place of launching and landing, the thrust of the launching rocket, and the recovery method.

G.P.O. SPACE TESTS.—As forecast in our issue for Mar. 30, the G.P.O. is to establish a ground terminal for experimental tests with American communication satellites in Cornwall. Announcing this, Sir Ronald German, Director-General of the Post Office, said the ground station would cost about £500,000. Contracts were already being arranged.

Commercial Aviation Affairs

SEABOARD AT L.A.P.—A new 18,000 sq. ft. warehouse on the south side of London (Heathrow) Airport will be brought into use by Seaboard World Airlines next month in preparation for the introduction of Canadair Forty-Fours in July. Full customs facilities will be available at the warehouse, which is a part of the Field Aircraft Services hanger.

M.E.A. PROFIT.—In 1960 Middle East Airlines, a B.O.A.C. associate company, made a profit of £25,000 after payment of all interest. This was achieved in spite of severe jet competition on all the airline's routes during the year; delivery of the M.E.A.'s Comets did not start until December, 1960, and they were not fully operational on the company's international routes until March, 1961. In 1959 M.E.A.'s profit was about £22,000.

EL AL ORDER.—Two Boeing 720Bs have been provisionally ordered by El Al, for delivery early next year. The order is subject to government approval.

BRAZILIAN REORGANIZATION.—Varig and REAL Aerovias, two of the three major Brazilian airlines, are to establish a jointly owned subsidiary, Aerovias Brasilia, to combine the international operations of the two companies.

CARGO AGREEMENT.—The IATA North Atlantic cargo-rate meeting ended in agreement last Monday. The new rate structure, which resembles that proposed by B.O.A.C. (see our issue of Feb. 24, p. 199), comes into force on Sept. 1.

OZARK ONE-ELEVENS. — Ozark Airlines' intention of buying five B.A.C. One-Elevens, reported in our previous issue, was confirmed in St. Louis on May 11 by Mr. Joseph H. Fitzgerald, the company's president. He said that the order was worth about $11.5 million and that the aircraft would be delivered in 1965. It is the first order for pure jet transports by an American local service airline.

MARCH TRAFFIC. — Provisional M.o.A. figures for March show an increase of 22% in U.K. airlines' traffic on scheduled and I.T. services. Capacity increased by 35% and the overall load factor fell from 61% to 55%. Final figures for February show a 16.4% increase in load ton miles, a 26.3% increase in capacity and a fall in overall revenue load factor to 52.1%.

MALAYAN VISITOR.—On May 12 Mr. Enche Sardon, the Malayan Minister of Transport, who is touring British industries, flew from Gatwick to Middlesbrough in a Handley Page Dart Herald.

A.T.C.C. MOVE. — The Oceanic A.T.C.C. at Prestwick is likely to be transferred to Preston in a few years as part of the reorganization of the U.K. control system. It is anticipated that the Scottish A.T.C.C. will remain in Ayrshire; the present Prestwick A.T.C.C. is to be demolished to make way for the new airport terminal area.

NORWICH AIRPORT?—The possibility of developing the R.A.F. base at Horsham St. Faith as an airport for Norwich is being investigated by an airport committee set up by the local council.

CLEVELAND-LONDON SERVICE.—On May 5, T.C.A. inaugurated a Cleveland-London service by way of Toronto, using DC-8s. The eastbound journey time is less than eight hours and the service will operate four times a week from the beginning of June.

POINT NINE SEVEN 990.—The Convair 990 with modified nacelles, which resumed its test flight programme on Apr. 20, reached a T.A.S. of Mach 0.97 at 22,500 ft. (675 m.p.h.) on May 8. The 990 will be certificated for operations up to Mach 0.91.

AEROFLOT TO CUBA.—General Loginov, the head of Aeroflot, said in Moscow recently that Russia was planning to inaugurate services to Cuba and several other States in the Western Hemisphere and in South East Asia. New Aeroflot equipment, including the An-24 and the Tu-124, was demonstrated for the first time in Moscow last week.

F.A.A. RULINGS.—A new regulation by the F.A.A. requires flight recorders to be carried on all jet transport aircraft, and on all transports operating above 25,000 ft., for all flight checks, training flights, ferry flights, airworthiness tests, etc., with certain exceptions; previously, only aircraft on air carrier operations were required to carry recorders. Another rule effective next week bans the use of portable FM radios on U.S. civil aircraft, because of interference with aircraft VHF radio.

FINNAIR PROGRESS.—The Finnish airline Aero O/Y (Finnair) recorded a profit of 15.6 million Finnish marks (about £17,350) in 1960. Rapid progress has been made by the company with the introduction of three Caravelles, and traffic on the international routes, which represent 64% of Finnair's activities, increased during the year by 36%. Gunnar Korhonen, supreme leader of the Ministry for Trade and Industry, has been appointed president in succession to Lt.-Gen. Leon Grandell.

ISRAEL DELIVERY. — The first Boeing 707-420 for El Al Israel Airlines was delivered at Seattle on May 7. It was named "Shehecheyanu" and was delivered to New York the same day. El Al has ordered three 707-420s and two Boeing 720Bs.

SAHARA ACCIDENT.—An Air France L-1649A Starliner crashed in the Sahara Desert while en route from Fort Lamy to Marseilles on May 10. The 69 passengers and nine crew were killed. Preliminary reports suggest that a catastrophe occurred at the cruising altitude of 20,000 ft.; the tail unit and other components were found a mile away from the main wreckage.

News About People

VICKERS-ARMSTRONGS NEWS.—Mr. A. W. E. Houghton, general manager and a director of Vickers-Armstrongs (Aircraft), Ltd., since 1957, has been appointed assistant managing director. Air Marshal Sir Geoffrey Tuttle, a director of the company since last October, becomes general manager in succession to Mr. Houghton.

LEAVING AVRO.—Chief designer of A. V. Roe and Co., Ltd., since July, 1955, Mr. J. R. Ewans is to leave the company at the end of this month. He joined Avro's from Blackburn Aircraft, Ltd., in 1949, as chief aerodynamicist and in May, 1955, became deputy chief designer.

OVERSEAS APPOINTMENTS.—Mr. Harold Seabrook-Smith has been appointed sales manager (charter) of Overseas Aviation (C.I.), Ltd., and Mr. Norman Bradshaw has become sales manager (scheduled services) for the same company.

MARCONI CHANGES. — New appointments announced recently within Marconi's Wireless Telegraph Co., Ltd., are Mr. R. Telford as general manager relinquishing his position as general works manager; Mr. H. J. H. Wassell as works manager, Chelmsford; Dr. E. Eastwood as director of research; Mr. E. N. Elford takes up special duties particularly in connection with the company's activities in the defence field. Dr. T. W. Straker succeeds Mr. Elford as manager, radar division. Mr. F. S. Mockford ceases to be commercial manager in order to take up special duties for the managing director and is succeeded by Mr. F. Wheeler. Mr. H. Baker is now deputy commercial manager.

MARCONI GUEST.—Air Chief Marshal Sir Edmund Hudleston, V.C.A.S., visited the Chelmsford works of Marconi's Wireless Telegraph Co., Ltd. on May 8. Here he discusses airborne equipment with Mr. H. J. H. Wassell, works manager (left), and Mr. F. N. Sutherland, the managing director (right).

REPRESENTING SOLARTRON.—Mr. Norrie McFarlane has been appointed Scotland and Ireland regional manager for the Solartron Electronic Group, Ltd. He was an experimental engineer with Ferranti, Ltd., working on radar and navigational aids before joining Solartron in 1959.

H.S.A. PUBLICITY.—Mr. C. A. G. Hicks is to head a London-based central publicity department set up to co-ordinate all Hawker Siddeley Aviation advertising, public relations, exhibitions and publications. He is responsible to the sales director, Mr. J. A. R. Kay. Mr. J. K. Corfield, publicity manager of Armstrong Whitworth Aircraft, Ltd., for the past three years, has been appointed H.S.A. public relations officer. He will be assisted by Mr. David Masters, former Fairey Aviation test pilot at Manchester, who fills the new post of technical press officer.

FALCON APPOINTMENT. — Mr. Frederick Beezley has been appointed assistant managing director of Falcon Airways. He was previously a legal assistant in the Director of Public Prosecutions Office.

BELLING-LEE MANAGER. — We wish to make it quite clear that the appointment of Dr. A. C. Robb, recorded in our issue of Apr. 27, was as technical manager of Belling and Lee, Ltd. This company has no connection with Belling and Co., Ltd.

Air Transport

A Bigger Cake to Share

JUGGLE as one may with the involved problems posed by the multiple applications from the "independent" operators for traffic rights which have previously been a virtual monopoly of the two airline corporations there is, in the ultimate, only one practical solution: the total British proportion of traffic must be increased.

On the face of it, this solution may seem to be as absurdly impossible as it is obvious. But is it so impossible? The details of inter-governmental bilateral agreements are not normally published and nobody supposes that the associated horse-trading is limited simply to mutual agreement on airline schedules and capacities. Nevertheless, the timetables show that, so far as direct airline interests in bilateral agreements are concerned, the arrangements usually involve something like parity in the capacity offered by the British and other national airlines concerned.

Yet, clearly, there must be, at least on services to and from the U.K., very few cases in which more traffic is generated elsewhere than in this country—and many obvious cases in which the total traffic is preponderantly British.

The Ministry of Aviation can hardly be expected to relish the idea of entering into a long and protracted series of renewed international negotiations—but this seems to be the only way in which a rational and equitable solution can be found to the multiple traffic-rights problem. There may possibly be some significance in the fact that no Ministerial direction has apparently (at least so far) been given to the A.T.L.B. in the matter of the 100 or so applications for parallel services in Europe.

Under the Act the Minister can specifically tell the Board to refuse an application which, if approved, would involve government negotiations which he, the Minister, considers "for the time being" to be "inexpedient." It may be that the need for the re-negotiation of bilaterals will be accepted if the Board rules in favour of additional competitive services, and it may be that means will be devised for ensuring that the new operators carry their share of unprofitable routes.

Meanwhile, the two corporations seem to be absolutely right in their refusal to consider the pre-hearing discussion of possible compromise solutions. It is for the Board to decide on these issues—and the fact that the Minister retains an overriding power of veto is neither here nor there until this power has actually been seen to be applied.

Last week's printed exchanges—with B.U.A. replying to comment by Lord Douglas, B.E.A.'s chairman, in the corporation's house magazine—merely served to show that both sides hold reasonably sound positions according to their individual viewpoints. B.E.A. is "seeking to safeguard a most successful and profitable national undertaking which has been built up . . . over the past 15 years and to ensure the development which is essential to continued success." B.U.A. is, Mr. F. A. Laker said, "merely staking a claim to an interest in a growing industry which can only benefit the passenger at a time when air traffic is rapidly expanding."

A significantly interesting point is that the British United/Cunard Eagle/B.E.A. hearings on European rights next month, like this week's Cunard Eagle/B.O.A.C. hearings on North Atlantic rights, are, in basis, struggles between established airlines and shipping companies which have seen the red light. As Mr. Laker put it in his statement last week, the B.U.A. shareholders "are largely shipowners from whom the airlines, including his [Lord Douglas'], have been taking traffic for years." Shipping interests have a 71% holding in British United, and Cunard Eagle is wholly owned by such interests.

Amidst last week's one-day storm (of printer's ink) it was vaguely encouraging to read one particular sentence in the *B.E.A. Magazine* article which had not found a place in the newspaper quotes. "To imply," wrote Lord Douglas, "that B.E.A. is in some way acting improperly in this [safeguarding its interests] . . . reminds me of the proverbial notice in a French zoo: 'Cet animal es trés méchant. Quand on l'attaque, il se défend.'"—H.A.T.

B.E.A. Profit Reduced

A FALL in load factor of 2.5 points is said by B.E.A. to be largely responsible for a decline in profit for the 1960/61 year from the previous year's record level. Preliminary estimates show that a profit of at least £1¼ million was made after payment of interest charges on capital; this represents less than 3% of the corporation's turnover and compares with the profit of £2 million in 1959/60.

During the year, B.E.A. carried more than four million passengers, and more than 50,000 tons of freight and mail. Available seat miles exceeded 2,000 million for the first time; revenue seat miles totalled 1,393 million at a passenger load factor of 66.7%. The fall in overall revenue load factor to 65.2% is indicated by the disparity in capacity ton-mile and load ton-mile increases—of 24% and 19% respectively.

When is an Airline . . .?

AS a means of securing a right to be heard by the Air Transport Licensing Board at its public hearings into air service licence applications, the Association of Supervisory Staffs, Executives and Technicians (ASSET) is reported to have purchased an airline.

Known as Trailblaze, Ltd., the company at present has no aircraft. Its directors are Mr. Keith Milner, president of ASSET, Mr. Clive Jenkins, general secretary of ASSET, Mr. Ian Mikardo, former Labour M.P., and member of the Labour Party National Executive, and Mr. John Diamond, Labour M.P. for Gloucester.

The Civil Aviation (Licensing) Act 1960 is specific about those who have a right to be heard by the A.T.L.B. as objectors to licence applications. They comprise:—

1. The holder of any air service licence.
2. Any applicant for such a licence whose application has not yet been determined by the Board or is the subject of an appeal to the Minister.
3. The holder of an aerodrome licence.
4. A non-aviation transport operator.
5. Government departments.

As a non-operating company, Trailblaze apparently could appear before the Board under the second category above, by making a series of dummy applications for air service licences. The cost of so doing could be minimized if the applications were for Class C licences, at £2 an application. Such action might be regarded as outside the intent of the regulation, but the loophole, if it be so regarded, clearly exists. Trailblaze would further have the right to appeal to the Minister against any A.T.L.B. decision in a case to which it had been a party.

The primary purpose of ASSET in taking this step is understood to be a continuation of its campaign to obtain improved working conditions and pension schemes for its members.

Balance Sheet for 1960

THE annual report of ICAO for 1960, which was issued in Montreal last week, shows a number of trends, one or more of which may be significant. For instance, the World's scheduled airlines returned a smaller profit than in 1959; the accident rate was considerably higher; the average weight load factor fell from 56.9% to 55.5%; and North Atlantic services showed the largest of all regional increases in passenger traffic.

Preliminary returns indicate that scheduled airlines enjoyed an overall profit of about $50 million on total revenues of $5,500, or about 1%; the 1959 profit was $105 million.

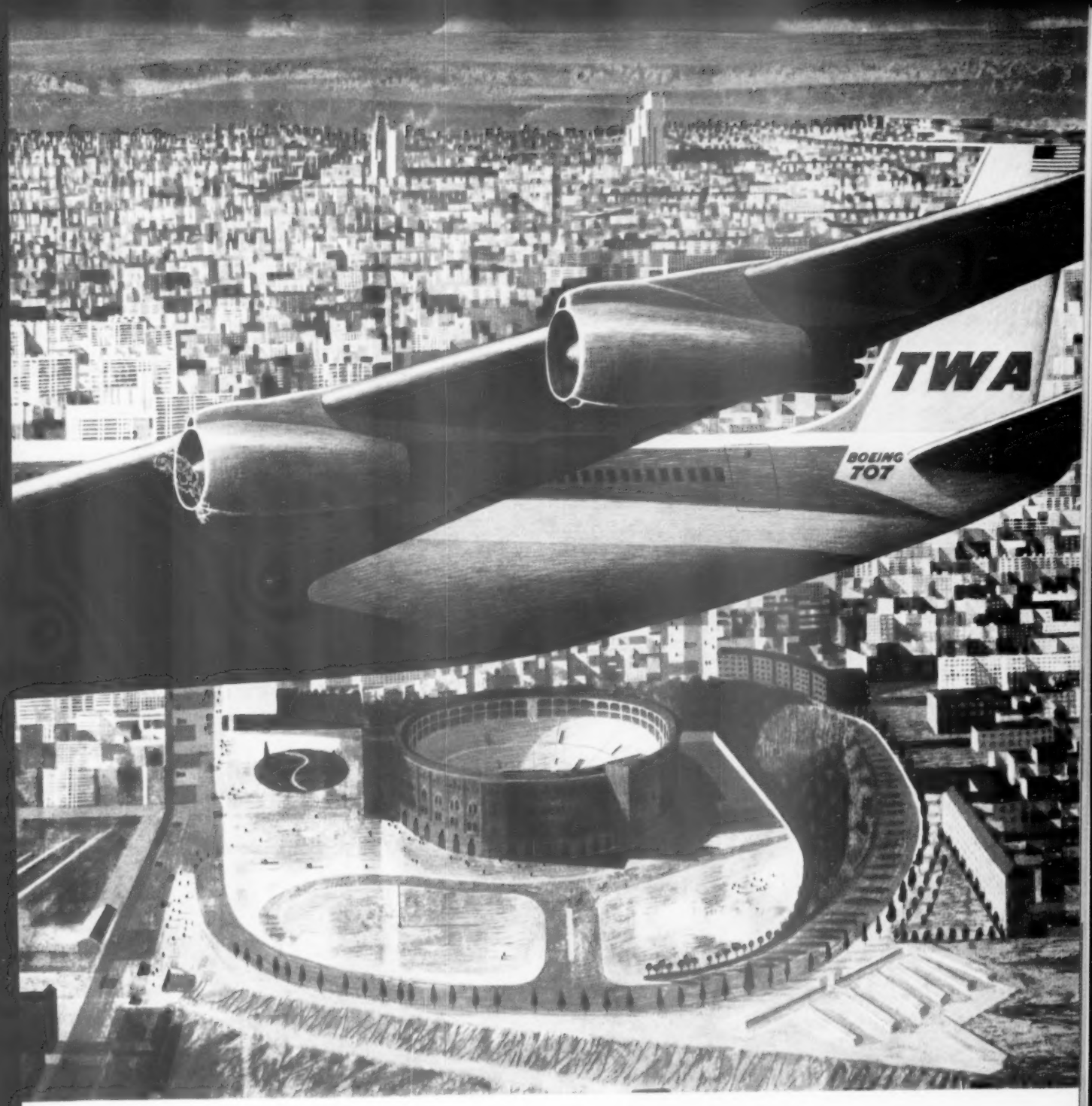
The passenger-fatality rate rose from 0.95 per 100 million passenger-miles in 1959 to 1.25—which was the highest since 1956. The highest rate since 1949 was 3.15 in 1950. However, of the 32 fatal accidents reported, only three involved turbojets, though these aircraft were responsible for about a third of the passenger-miles flown—and for a volume of operations about equal to the World total in 1951 when there were 20 fatal accidents.

A total of 1,761,000 passengers were carried on North Atlantic scheduled services—an increase of 395,000 on the 1959 figure. If charter and special flights are included the total for 1960 was 1,920,000—or 25% more than that for 1959.

Starways to Africa?

AN application has been made to the A.T.L.B. by Starways, Ltd., for a licence to operate economy and Skycoach services to Africa from Glasgow, Liverpool and Manchester. Points to be served would be Gibraltar, Bathurst, Freetown, Accra and Lagos, with technical stops at Jersey, Bordeaux and Las Palmas. The application specifies equipment as Viscounts or DC-4s, and frequency in accordance with traffic demand.

Typical of the economy-class fares listed in the application are the following (all return fares, from Glasgow—return fares from Liverpool/Manchester are £4-£5 less): Gibraltar, £44 1s. 6d.; Bathurst, £164 14s.; Freetown, £179 2s.; Accra and Lagos, £184 10s. Skycoach fares would be available to and from Gibraltar and Bathurst only, for passengers resident in U.K. territories, at 85% of the economy-class fares.



TWA SuperJet to all America

TWA, the SuperJet Airline, serves more than 70 major U.S. cities from 23 world centres. The airline, which pioneered over-weather flying in the thirties with an earlier Boeing, now carries more than 6 million passengers annually on its network of world routes from San Francisco throughout the U.S.A., Europe, Africa and the Orient. One of TWA's four main transatlantic routes serves Madrid, where—as at other stops on TWA routes—the 21,000 gallon tanks of the Boeing 707 Superjet are replenished by AIR BP in a matter of minutes.

Fast flying TWA... fast fuelling AIR BP

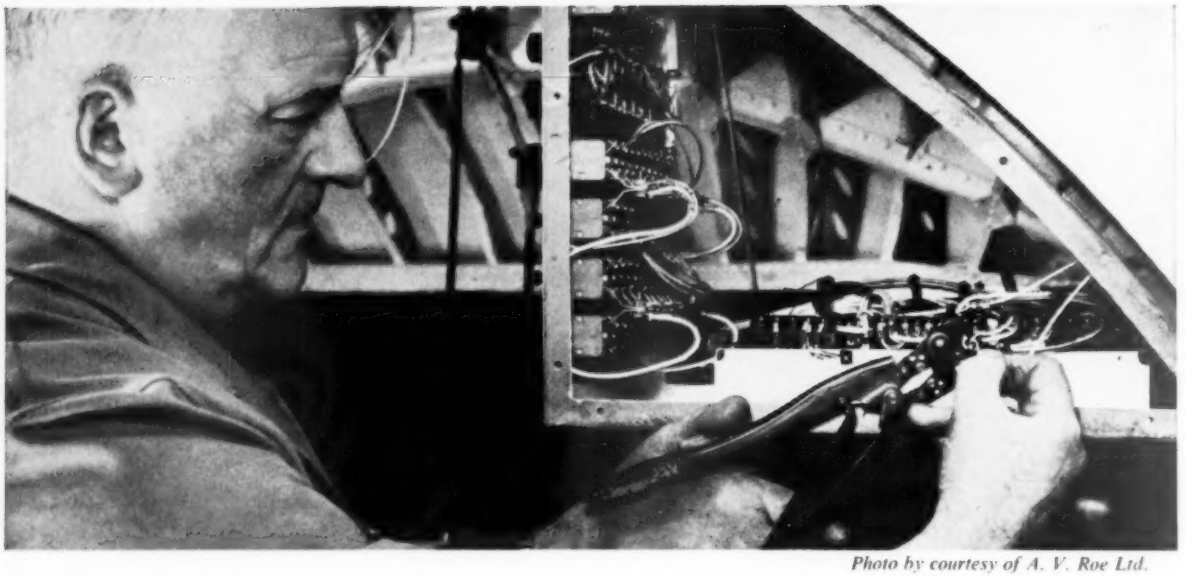


Photo by courtesy of A. V. Roe Ltd.

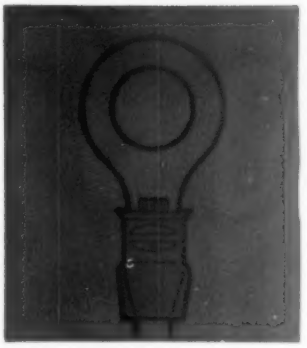
★ AVRO

USE AMP

SOLDERLESS WIRING DEVICES

The photograph shows A-MP terminals being attached to the wiring of the cockpit distribution panel of the new Avro 748. A-MP solderless wiring devices are already used in 90% of aircraft in the free world to-day, and the increasing complication of wiring systems makes A-MP products indispensable.

Photo by courtesy of A. V. Roe Ltd.



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AP154

Irish International Airlines' Quarter-Century

NEARLY 25 years ago, on May 27, 1936, a five-seater D.H. 84 Dragon ("Iolar") left Baldonnel Aerodrome, Dublin, for Whitchurch Aerodrome, Bristol, on the first service operated by Ireland's newly formed airline—Aer Lingus, or "Air Fleet."

Baldonnel was (and is) the headquarters of the Army Air Corps and then served also as Dublin's civil aerodrome. Dublin Airport, Collinstown, had still to be laid down and Desmond Fitzgerald's terminal building had yet to be designed—but work on this airport was soon to be started, and from January, 1940, was due to be the airline's base.

The take-off was watched by 11 of Aer Lingus' total staff of 12—the other member, Capt. O. E. Armstrong, was, in fact, the pilot of the Dragon. By comparison with the staff of a dozen and one five-passenger aeroplane in May, 1936, Aer Lingus and its long-haul associate, Aerlinte Eireann, now have a staff of about 2,100 and a fleet of 22 aircraft with a total seating capacity for well over 1,000 passengers. Nevertheless, in the first full year of operation—on the Dublin-Bristol run and later also on services to London, the Isle of Man and Liverpool (the last two in co-operation with Blackpool and West Coast Air Services)—Aer Lingus carried 10,650 passengers.

A little less than a year after operations started a company, Aer Rianta, was formed for the overall management and development of Irish civil aviation, and Aer Lingus became, and remained until 1946, its wholly owned operating subsidiary. Development of air routes ceased during the War, but Aer Lingus maintained, from 1939 to 1945, the one air link between Eire and the U.K., using Liverpool (Speke) as the U.K. terminal except for a two-year period when the services were operated to and from Manchester.

In 1946 a bilateral agreement was reached with the U.K. whereby Aer Lingus retained exclusive traffic rights between the two countries, while B.E.A. (and, for a time, B.O.A.C.) enjoyed a 30% (later 40%) shareholding in the Irish company.

Many people may have forgotten that North Atlantic operating plans were initially made by Aer Lingus as long ago as

Below are two of Aer Lingus' seven Fokker F-27s on the apron at Dublin's Collinstown Airport. They were ordered in June, 1956, to operate over the shorter medium-traffic and seasonal routes.

On the left is the D.H. Dragon with which the first Aer Lingus service was operated in May, 1936. Below is one of the Viscount 808s which today operate over the heavier-traffic regional routes.

HIGHLIGHTS OF A QUARTER-CENTURY

1936
May 22. Aer Lingus incorporated.
May 27. First service: Dublin (Baldonnel)—Bristol, D.H. Dragon. Later, services to Isle of Man, Liverpool and London (via Bristol).

1937
Apr. 5. Aer Rianta formed for overall civil aviation management and development. Aer Lingus wholly owned by Aer Rianta until 1946.

1939
Sept. 1. All services suspended on outbreak of War.
Oct. 23. Direct service to Liverpool started with D.H. 86s. This service was maintained throughout the War (Manchester as terminal, 1940–1942) with, later, DC-3s.

1940
Jan. 19. Aer Lingus moves to newly opened Dublin Airport, Collinstown.
May 7. First DC-3 in service.
Aug. 12. Experimental service Dublin—Shannon opened (ceased Oct. 30, 1942).

1945
Nov. 9. Dublin—London service restarted.

1946
Apr. 5. Bilateral agreement with U.K. giving Aer Lingus exclusive U.K.-Eire traffic rights with shareholdings for B.E.A. (30%) and B.O.A.C. (10%—later taken over by B.E.A.).

1946
Jne. 17. First service to Continent: Dublin—Paris.

1947
Feb. 26. Aerlinte Eireann formed for North Atlantic operations. Five Constellations later ordered.

1947—Contd.
Sept. 16. First three Constellations left Burbank on delivery flight.
Oct. 5. Atlantic proving flights started.
Nov. 3. Constellations introduced on Dublin—London (later Dublin—Rome) service.

1948
Feb. Transatlantic plans postponed indefinitely. Constellations later sold to B.O.A.C.

1951
Mar. Dublin—Manchester night mail service inaugurated.
Nov. Four Vickers Viscount 707s ordered.

1954
May. Viscount 707s enter service.

1956
Mar. Three (later six, later seven) Viscount 808s ordered.
Jne. Five (later seven) Fokker F-27s ordered.
Aug. Anglo-Irish agreement revised to permit competitive services Dublin—U.K. and intermediate U.K. traffic rights for Aer Lingus. B.E.A. holding reduced to 10% (later 4.6% following increase in capital); remaining shares held by Aer Rianta.

1958
Apr. 28. Aerlinte Eireann starts North Atlantic services with L-1049Hs leased from Seaboard and Western.
Jne. Viscount 808s enter service.

1959
Mar. 11. Three Boeing 720-048s ordered.

1960
Dec. 14. First Aerlinte Eireann transatlantic service.

1947. Aerlinte Eireann was formed in that year and five Lockheed Constellations were bought. A change of policy caused the project to be dropped after proving flights had actually started. The L-749s were used for a while, in 1947-48, on the Dublin-London and Dublin-Rome runs, but were eventually sold to B.O.A.C. for a price which was more than adequate to cover the costs of the abandoned Atlantic programme. One of those who joined Aerlinte for the development of these services was Capt. J. C. Kelly-Rogers; he is now deputy general manager of the companies.

Meanwhile, Aer Lingus had, except for comparatively brief periods of Viking and Bristol 170 operation, settled down as a one-type operator with a fleet of a dozen DC-3s—and remained so until the first Viscounts, ordered in 1951, were delivered in 1954.

This fleet rationalization policy was also to be seen at later stages in the operator's history. The Viscount 707s, for instance, were taken out of service after Viscount 808s and Fokker F-27s (which had powerplants similar to those of the 808s) were introduced, and half the remaining fleet of 10 DC-3s were then prepared for sale.

In 1956 the U.K.-Eire agreement was again revised after 10 years of exclusive traffic rights for the Irish company. Competitive services were now to be allowed and Aer Lingus obtained traffic rights at Manchester for services to and from Europe. B.E.A.'s holding in the company was reduced to 10% and this later fell to 4.6% when the capital was increased.

North Atlantic services had been proposed for 1953 using aircraft leased from Seaboard and Western, but this plan was shelved. In April, 1958, services were finally started by Aerlinte on a similar basis, with Seaboard leasing L-1049Hs and flight crews for the operation. Heavy traffic was not expected on this all-economy service, but a later decision on the purchase of its own aircraft by Aerlinte depended on the realization of a certain minimum load factor.

In the event, the initial operations were very reasonably successful and approval was duly obtained for the purchase of three Boeing 720s (-048s) which were ordered in March, 1959, for introduction into service late in 1960. The first proving flight to North America was made on Nov. 23, 1960, and the 720s were put into regular North Atlantic service by Aerlinte on Dec. 14.

Although, for the purpose of this record, the two airlines have been treated separately, they now operate as one—Aer Lingus, Irish International Airlines—with a common management and staff. In the 25 years of its life Aer Lingus has developed a route system linking 28 cities in 12 countries with a fairly compact fleet consisting of three Boeing 720s, seven Viscount 808s, seven Fokker F-27s and—now used only for charter and similar operations—five of the DC-3s which had provided the backbone of the fleet during the formative post-war years.

The first of Aerlinte's three Boeing 720-048s after its delivery flight to Dublin. The 720s went into North Atlantic service on Dec. 14 last year.

Air Transport . . . .

Background to the One-Eleven

BRITISH UNITED AIRWAYS' purchase of B.A.C. One-Eleven short-haul jetliners, announced last week (see our previous issue, page 509), makes it unlikely that this independent operator will purchase de Havilland Tridents, despite a previously announced intention to do so. Explaining the One-Eleven order, Mr. F. A. Laker, B.U.A.'s executive director, makes the following points in favour of the B.A.C. aeroplane:

1. It provides a direct replacement for the Viscount 810, with the same passenger capacity.
2. A larger fleet of smaller aeroplanes (e.g., 10 One-Elevens rather than five Tridents) gives B.U.A. greater flexibility of operation.
3. Block speeds of faster aeroplanes, such as the Trident, Boeing 727 and Caravelle VI R, can be matched by the One-Eleven because of its better manœuvrability in the air and on the ground.
4. Take-off and landing distances of the One-Eleven are shorter, and noise levels substantially lower.
5. Seat-mile costs of the One-Eleven on the B.U.A. network are estimated to be lower than any other type evaluated for service in 1964.
6. The smaller passenger capacity of the One-Eleven allows B.U.A. to maintain the same standard of cabin service as hitherto, using three cabin attendants.

The initial B.U.A. order for 10 One-Elevens (delivery to begin in the autumn of 1964) is regarded as a replacement for the existing fleet of 11 Viscounts and is not dependent on the granting of new licences. The option on a further five will, no doubt, be taken up if B.U.A. succeeds in its application for a scheduled European network, while the purchase of VC10s is almost certain to follow, in due course, the granting of licences for the African and Far East services which are being sought. While the One-Eleven order is not in this sense conditional Mr. Laker made quite clear last week, however, that the whole future of B.U.A. itself may well depend on the outcome of these route applications.

As the first customer, B.U.A. has naturally exerted some influence on the basic specification of the One-Eleven, and development is now proceeding of a variant of increased gross weight and greater tankage to meet a B.U.A. requirement to fly London-Malta sectors non-stop in either direction with 67 passengers. The combination of range (1,134 naut. miles), runway length and temperature at Malta (5,995 ft. and 27° C. A.R.T.), and seasonal headwinds, make this the most difficult sector of the B.U.A. network and the aeroplane that can do this will fit all other routes, including the existing B.U.A. Safari services.

As we reported last week, British Aircraft Corporation has found much airline interest in the One-Eleven, especially in North America, where sales activities so far have been concentrated. According to Sir George Edwards, executive director (aircraft) of B.A.C., they are now "quite satisfied that this is the general formula of aeroplane that a number of airlines

are going to buy." The U.S. domestic market alone for this class of aeroplane is estimated at several hundred; it can be considered both as a replacement for the Viscount (130 in service in North America) and as a natural growth aeroplane for operators of Convairliners and DC-3s. With typical understatement, Sir George said: "It looks as though it could be worth going on with."

Continental Airlines, whose president, Mr. Robert Six, was recently at Weybridge, is on record as being "extremely interested" in the One-Eleven and is sending a senior evaluation team to England next month with a view to reaching a firm decision within the next 90 days. Ozark Airlines, a local-service carrier serving more than 50 cities in 10 Mid-west states, has written a letter of intent to order five, and Braniff Airways also had a senior team at Weybridge and Hurn recently.

British Aircraft Corporation has at present committed itself to building a batch of 20 One-Elevens—enough to allow initial deliveries to be made to several airlines by the summer of 1965. The Government has said it is "prepared in principle to contribute to the launching costs of the project." Depending on the standard of equipment and the particular variant of the design purchased, the One-Eleven first cost will range upward from £775,000 to more than £800,000. Design and production will be shared between Hunting, Bristol and Vickers, with the final assembly line at Hurn.

Sir George confirmed that the VC11 medium-haul project has been dropped, as we reported in our issue for Apr. 6. The One-Eleven is regarded as a better bet, not least because there is at present no other project going ahead in this class, whereas the VC11 would have to compete with other types already in production.

Customer surveys made by B.A.C. in the past few months have indicated an additional need for a smaller, lighter, less sophisticated version of the One-Eleven and this need is planned to be met with the B.A.C. 107. Powered by Bristol Siddeley BS.75s, the 107 will have a shorter fuselage, a lower basic standard of radio and equipment and will be an attempt to provide the simplest and cheapest possible jet transport. Its BS.75 turbofans are being developed as a private venture, undertaken primarily with the short-haul transport market in view; the first run is scheduled for next January, with flight trials to follow during 1962, and in-service availability in 1965.

Cunard Eagle Buys Boeings

CUNARD EAGLE AIRWAYS announced in New York on May 10 that it had placed an order worth approximately £6 million for two Boeing 707s. Powered by Rolls-Royce Conways, they are identified as 707-465s and will be delivered early in 1962. An option has been taken on a third.

Contrary to earlier reports, Cunard Eagle stated in London last week that this order was not conditional upon the granting of new route licences by the A.T.L.B., although the acquisition of the third aircraft, no doubt, would be. The Boeings will be furnished to mixed first/economy-class standards for use on the North Atlantic services (including Skycoach) to Bermuda, Bahamas and Miami, for which Cunard already has operating licences. One service is operated each week in pool with B.O.A.C.

The Boeing 707—Cunard Eagle's first jet purchase—has been chosen, the company says, for "its ready availability and its excellent operational characteristics. The company is currently considering the purchase of Vickers VC10 aircraft for delivery late in 1964."

Cunard Eagle is financing the purchase of the Boeing 707s by what it describes as conventional airline methods.

Last month details were announced of the Government loan and subsidy to the Cunard Steam-Ship Company, which now wholly owns Cunard Eagle Airways) for construction of a new "Queen" liner for the North Atlantic. Of the estimated total cost of £30 million, the Government is to provide three-fifths, of which £14¼ million is a loan at 6¼% interest and £3¼ million is a direct contribution to the cost. £12 million, plus any expenditure above £30 million, will be provided by the Cunard company.

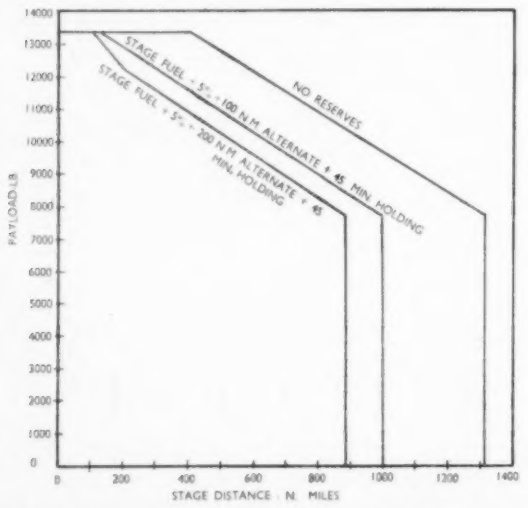
The Herald Enters Service

May 19 marks the introduction into service with Jersey Airlines of the Handley Page Herald. The significance of this event for both the airline and the manufacturers is discussed by F. G. SWANBOROUGH.

AT first sight, the introduction into service of a brand-new turboprop airliner may appear to be unduly ambitious for a small independent airline. Closer examination of the histories of Jersey Airlines and of the Handley Page Herald suggests, however, that this step is not only a logical one but one which is well within this operator's abilities.

The reasons why this should be so are twofold: Jersey Airlines is a vigorous and rapidly expanding company, still in the effective and day-to-day control of one man, with a compact network of high-density and short-haul routes radiating from the Channel Islands; and the Herald is a docile, economic airliner, particularly well developed and powered by the World's most reliable turboprop engines.

The first Herald service carrying fare-paying passengers is scheduled for Friday, May 19, on the route Bournemouth (Hurn)-Guernsey-Jersey, followed by the first Gatwick-Jersey operation on the next day, and the first Jersey-Paris flight before the end of the month. Initially, Heralds will be operating daily on the Bournemouth and Gatwick services and twice a week to Paris. As utilization builds up, they will be applied as needed to these and other routes; using two aircraft, it is hoped to achieve about 1,000 revenue flying hours with the Herald during the July and August peak.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NO RESERVES
STAGE FUEL + 5% + 100 N.M. ALTERNATE + 45 MIN. HOLDING
STAGE FUEL + 5% + 200 N.M. ALTERNATE + 45 MIN. HOLDING

The payload-range performance of the Herald 200, with reserves as stated, in I.S.A., still air, at 40,000 lb. take-off weight.

To start with, Jersey Airlines is using two leased Herald 100s, permitting introduction of the type only nine months after the order was placed. The contract, however, was for six of the longer-fuselage Herald 200s, the first two of which will be delivered to Jersey Airlines later this year. The contract calls for delivery of two more each in 1962 and 1963, or, as now seems more likely, all four in 1962.

Development of the Herald 200, with accommodation for 50 passengers in the basic version, was a key factor in Jersey Airlines' choice of this particular aircraft rather than the Avro 748 or the Fokker Friendship. Mr. M. L. Thomas, chairman and managing director of the airline (and its founder in 1948) has said that without the six extra seats offered by Handley Page, it would have been almost impossible to separate these three types, although he had a strong personal preference for a high-wing layout because it brought the cabin floor closer to the ground. This was an important point in high-density, high-frequency operations where turn-round times were very important. There was also a company preference for British equipment, and delivery dates and first cost had to be considered.

The first leased Herald 100 (G-APWA, the first production aircraft) was delivered to the company on April 17 and crew training began two days later. Seven captains and six first officers have now converted to the Herald—enough to maintain schedules initially. Jersey Airlines has 25 captains and 24 first officers. The Herald captains, including Capt. D. H. Stuart, who is responsible for the training programme, all attended Rolls-Royce and Handley Page courses earlier this year, and have completed a 20-hour conversion programme on the Herald since its delivery, including route proving flights.

The second leased Herald will be G-APWB, destined eventually for B.E.A. For the Herald 200s, a distinctive new colour scheme is being developed, featuring blue and yellow trim lines down the fuselage. The interior décor has been developed in collaboration with Handley Page, who retained Charles Butler as adviser. A basic 50-seat layout has been adopted by Jersey, although a high-density arrangement for 56 passengers could be used. Jersey has also adopted, with few modifications, the cockpit layout developed by Handley Page for B.E.A. The

(Continued on page 547)

BS
AERO POWER

Olympus—for supersonic economy at Mach 2 plus

An advanced version of the Bristol Siddeley Olympus is now under intensive development for British Aircraft Corporation's TSR 2. It will give this very advanced tactical/support reconnaissance aircraft an exceptional performance at speeds up to Mach 2 and over.

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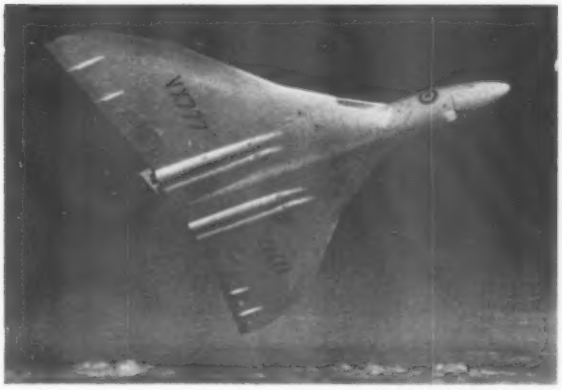
The Olympus has the ideal thermodynamic cycle for the economic propulsion of a supersonic aircraft at Mach 2 plus and embodies all the qualities essential for such an application: high power at high altitude; extremely low fuel consumption; great operational flexibility; a long overhaul life; a very high thrust/weight ratio; and excellent handling qualities.



Avro Vulcan Mk 2 V-bomber.

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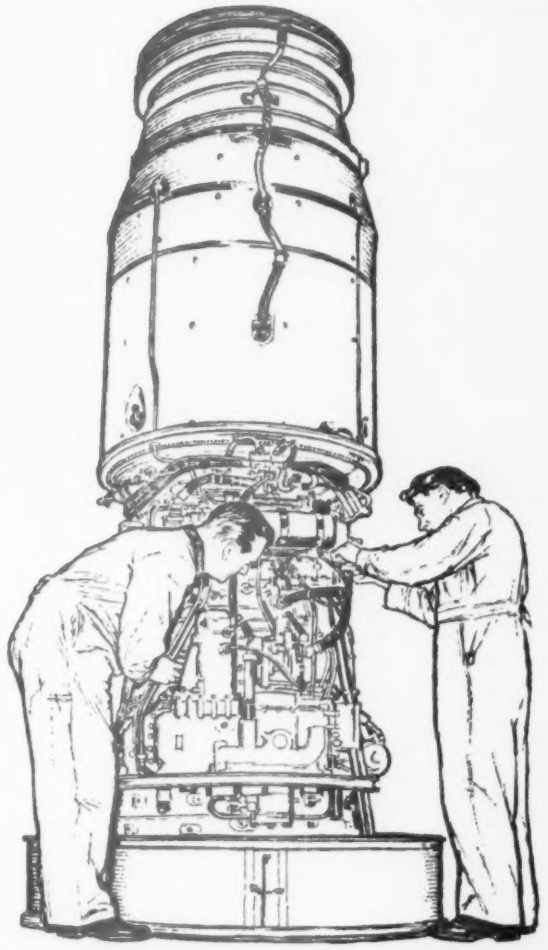
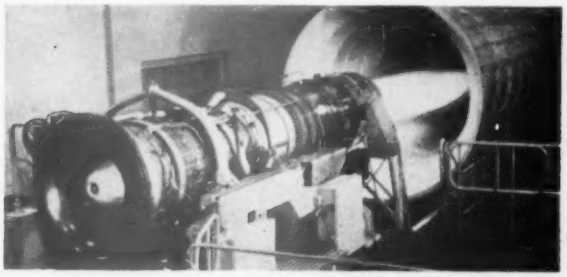
The Olympus has proved itself in several years' service, as the powerplant of the Avro Vulcan V-bomber, to be one of the most successful turbojets ever built. Maintenance is exceptionally low—last year for example, on a 26,000-mile round-the-world tour, the maintenance required was negligible.



The truly astonishing built-in potential of the Olympus has been confirmed by the three fold increase in power from the 11,000-lb thrust dry of the original production engine, to the 33,000-lb thrust with reheat of the latest version.



Olympus under test with reheat in operation

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Already selected for the RAF's most up-to-date supersonic aircraft, the Olympus will clearly require only minor changes to adapt it to the requirements of a supersonic airliner in the same speed category.

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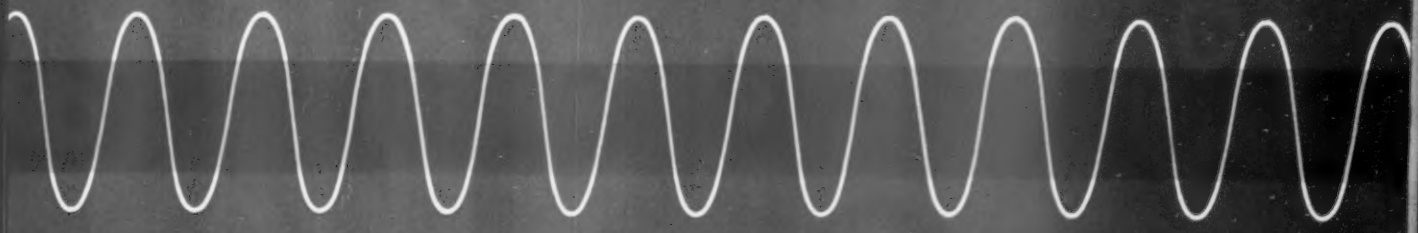

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It is with great interest that I learn that you have decided to place orders for the Handley Page 'Herald' to augment your fleet of aircraft.

When Sir Frederick Handley Page asked us to co-operate on the undercarriage and hydraulic equipment for the 'Herald' we were very happy to accept the invitation and to assist by developing and supplying prototype equipment as our contribution towards this important private venture.

Our long and friendly connection with 'Handley Page' goes back to the earliest 'Halifax' days and we have supplied the undercarriage equipment for every Handley Page type since that time. It is therefore with considerable pride and pleasure that we congratulate Jersey Airlines on choosing the 'Herald', and extend good wishes for long and successful operation when the aircraft goes into service on May 19th.

We will stand behind the aircraft, with Messrs. Handley Page, and ensure after-sales service and 'off-the-shelf' spares in accordance with our normal practice.

C. W. Sharp.

C. W. Sharp.
Managing Director.

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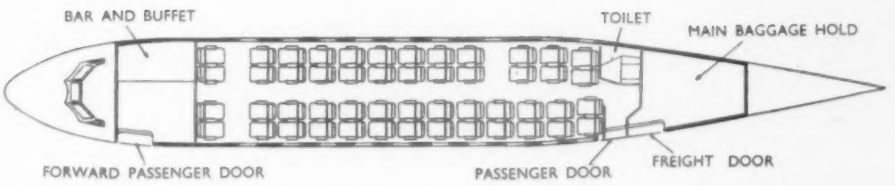
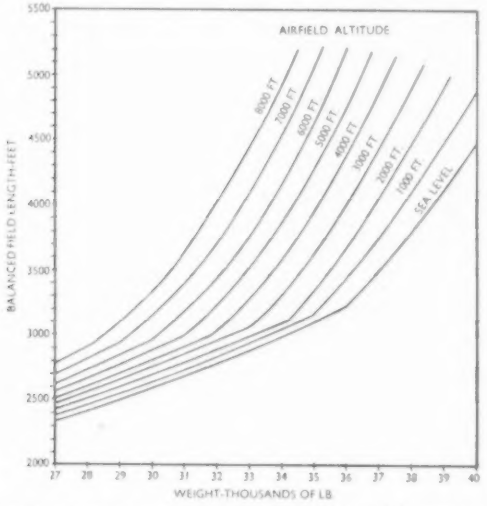


Layout of the Jersey Airlines' Herald 200, with 50 seats and a forward bar unit.

Decca Mk. 10 Flight Log is relocated on the centre roof panel to leave space on the main panel for cloud collision radar, which may be fitted eventually, and the radio equipment to Jersey's specification comprises Bendix twin VHF and single ILS/VOR, with a single Marconi AD722 ADF.

Passenger loading simultaneously through front and rear doors of the Herald is planned, as a ground-time saver, but only the rear door will be used for deplaning. A new feature, so far as Jersey Airlines is concerned, is the provision of a bar unit to sell spirits and cigarettes. This step accedes to



Balanced field lengths for the Herald 200, I.S.A. conditions, with one engine failed at critical V_1.

popular demand, and the company is in process of fitting bar units also in its fleet of eight DC-3 Dakmasters. The fact that this may well give Jersey Airlines a competitive advantage over B.E.A. on its London-Jersey route is not to be overlooked.

Jersey History

That Jersey *is* in direct competition, and not in pool, with B.E.A. is not always realized. There are some limitations on capacity in the licence for the London-Channel Islands services, but the company does not find it difficult to fill its aeroplanes most of the time, and in 1960 achieved an overall average passenger load factor of 74%. Since Mr. Thomas founded the company in 1948 with a single Proctor, the story has been one of continual growth. The fleet expanded through de Havilland Rapides to, eventually, seven Herons—Jersey Airlines being the first airline to use this type. Last year, as the traffic growth continued, DC-3s were added to the fleet—six from Transair and, more recently, two from B.E.A. The Heron fleet has been reduced to four, but there are no immediate plans to dispose of any more aircraft despite the acquisition of Heralds.

In 1949, Jersey Airlines carried 6,000 passengers. This figure had increased to 60,000 in 1954 and 250,000 in 1960; bookings to date make a total of more than 300,000 certain for 1961. Throughout this period of growth, the company's share capital has remained unchanged, and although a 25% interest in the company was sold to B.E.A. in 1956 in exchange for operating rights in the inter-island services, Mr. M. L. Thomas personally retains 75% of the shares. The Civil Aviation Act (1960) and the formation of the Air Transport Licensing Board has, in Mr. Thomas' view, sufficiently assured the company's future to permit public investment in Jersey Airlines, and this is a development which now might be expected.

With the Herald, Jersey Airlines should be able to embark on a new period of prosperity and expansion. Plans have already been made for services between Jersey and Amsterdam, Jersey and Nice, and Exeter and Cork, to be started later this year, and applications for other new routes are being considered by the company.

Herald Development

The Herald enters service with Jersey Airlines with a particularly good record of development and proving which includes some 1,600 hours with three of these Dart-engined aircraft, and more than 200,000 miles of overseas proving and demonstration flights. Key dates in development of the Herald were: the decision to change the powerplants from Leonides Majors to Darts in May, 1957; the first flight with Darts on Mar. 11, 1958; the Government-sponsored B.E.A. order for three announced in June, 1959; the Jersey Airlines' order in September, 1960, and the granting of an unrestricted Transport (Passenger) category certificate of airworthiness towards the end of 1960.

Development of the Herald 200 began when the certification trials with the Herald 100 showed that the aircraft had quite a lot of performance in hand. At the initial certification weight of 39,000 lb., operations in temperatures up to ISA + 30°C. provided no difficulty, and one obvious way of taking advantage of this situation was to increase the aircraft's gross weight and cabin capacity for operations where airfield length was not significant. Even at the new weight of 40,000 lb., the airfield performance of the Herald 200 is most satisfactory, as the accompanying curve shows. Further weight increases can be expected in the course of normal development of the aircraft.

Extending the fuselage forward of the wing by 42 inches, to produce the Herald 200, proved a comparatively simple matter and no other modifications of any kind have been necessary, apart, of course, from lengthening control runs and cables. The conversion involves a weight penalty of only 370 lb. The second prototype Dart Herald (G-AODF) was converted to a Series 200 earlier this year and is now engaged in development flying to obtain a C. of A. for this version by mid-summer.

The Herald production sequence is: one Series 100, leased to Jersey and to be returned to Handley Page; three Series 100 for B.E.A., of which one will be leased to Jersey for a few months; three Series 200 for Jersey, delivery starting in September; and then further 200s for Maritime Central, Nordair and other operators.

For Handley Page, the introduction of Herald service is of particular significance. About £4 million has now been spent over eight years on the private development of the aircraft, which has enjoyed mixed fortunes in this period. Now, for the first time, its performance in operational use will be demonstrated and will be closely watched by other potential customers. The high-density, high-frequency, short-haul Jersey operation is of a kind for which the Herald seems especially suited. The next 12 months will prove it.

The Herald 200 prototype is now undergoing flight trials. As this picture shows, the 42-inch fuselage extension is hardly noticeable.

EUROPEAN AIRCRAFT INDUSTRY

On the following twelve pages the West European aircraft industry and its major co-operative programmes are reviewed. The section opens with a survey of the industry's current status and its relationships with companies in Britain and America.

WHAT is the present status of the West European aircraft industry and what links does it have with the industries of the United States and Britain? These are big questions and it would require a large volume to answer them in detail. This article confines itself to the main trends.

For many years after the War the aircraft industries of Western Europe were not taken very seriously in Britain and the U.S. But those days are long past; European aircraft and missiles have an established position in World markets today.

After the War many British and U.S. aircraft companies could afford to ignore the European industry as a competitor in World markets. They could regard it merely as suitable for the construction of foreign aircraft under licence and the maintenance and overhaul of British and U.S. types equipping European air forces.

This view was probably inevitable; Europe emerged from the 1939-45 War with few effective facilities, either material or technical, for aircraft manufacture and national priorities were inevitably given to reconstruction rather than to aircraft development. During the War years only Germany in Europe had been in the main stream of aeronautical development—or possibly ahead of it. When fighting stopped, its aircraft industry was disbanded, its research and technical personnel dispersed, its factories destroyed or dismantled for reparations.

In fact, all the main aeronautical countries in Europe were defeated during the War; France in the early stages, Italy later and Germany at the end. So were Holland and Belgium; only Sweden and Switzerland were unaffected.

Defeat and the realities of economics and collective defence have greatly affected the post-War philosophies of West Europe's nations, and the development of their aircraft industries. The rigid nationalism of the pre-War years has gone and there has been an increasing trend towards co-operation in defence and economic matters, as well as at the political level. While the "United States of Europe" proposed by Winston Churchill in 1946 still remains a political pipe-dream, co-operation between European countries—including traditional enemies of the past such as France and Germany—is much closer than would ever have seemed remotely possible in 1939. Common defence planning under NATO and co-operation in the Common Market are significant. Such agreements, and the spirit to make them work, have had a powerful effect on the European aircraft industry which, as elsewhere, is primarily a defence industry.

Today Europe, and particularly France, produces aircraft such as the Caravelle and Mirage III and IV which are second to none in their field. This contrasts with the situation in the post-War years when Chipmunks, Meteors, Vampires, Venoms and Hunters were built under licence on the Continent and equipped several European air forces.

Today, the U.S. F-104G Starfighter is to be the main licence-built aircraft in Europe, and the future trend is toward multi-national production of European-developed aircraft such as the Transall C-160 and the Breguet Atlantic. In its relation with foreign airframe manufacturers Europe appears to have moved away from Britain and closer to the United States, as the list of agreements on p.551 indicates. But it is probably even more significant that U.S. companies are buying into European companies, which policy gives them closer control than do licence agreements. This development is examined in more detail later.

Only major airframe, missile and aero-engine companies can be discussed here. In the ancillary industry there are closer links between Britain and Europe than there are between the respective airframe companies. Both British and U.S. ancillary suppliers have many agreements with their European counter-

(*Continued on page 549*)

FRENCH VOGUE-SETTER.—French aeronautical exports have been boosted by sales of the Sud Caravelle, which pioneered the rear-engined clean-wing layout for jet transports.

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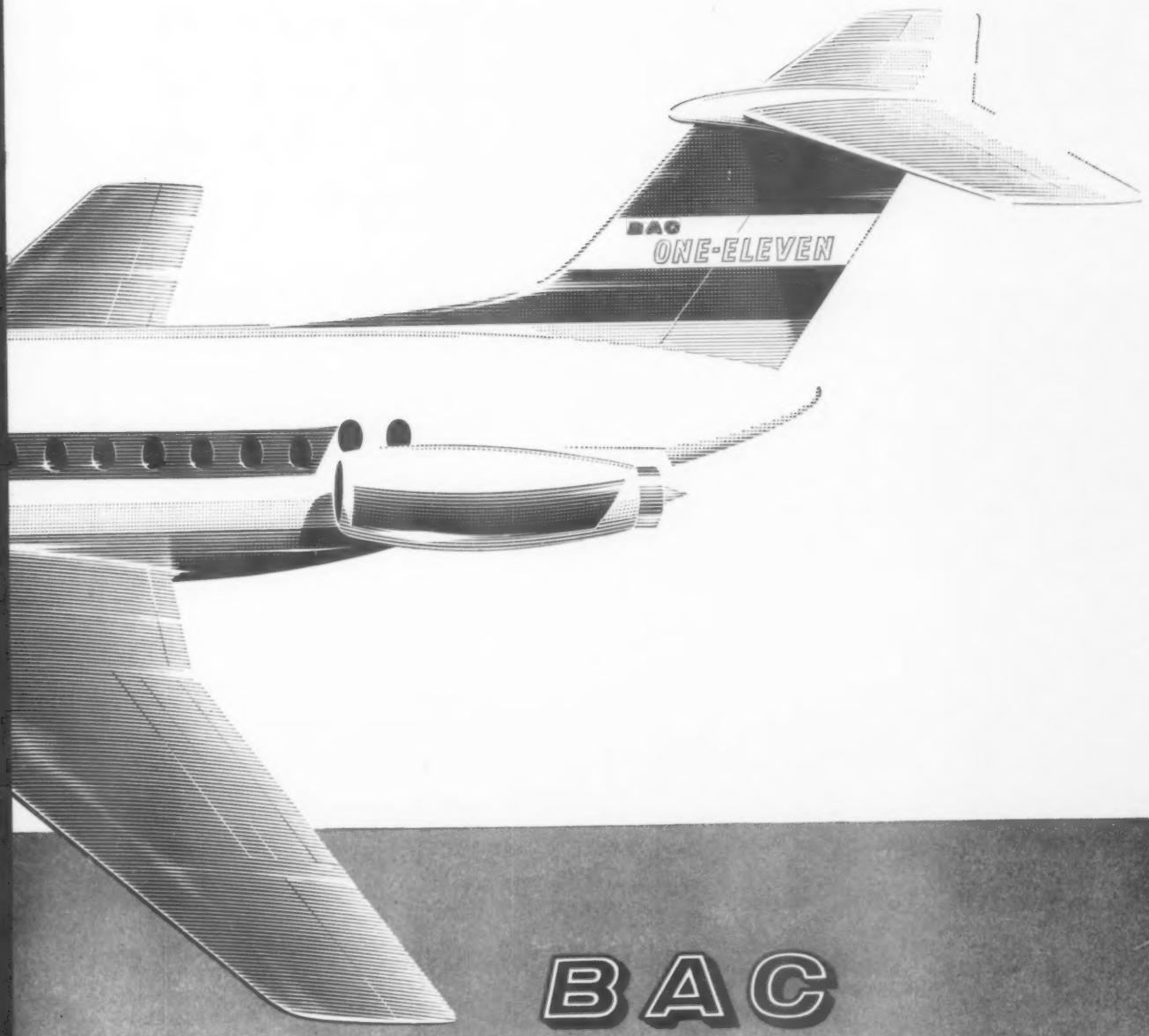

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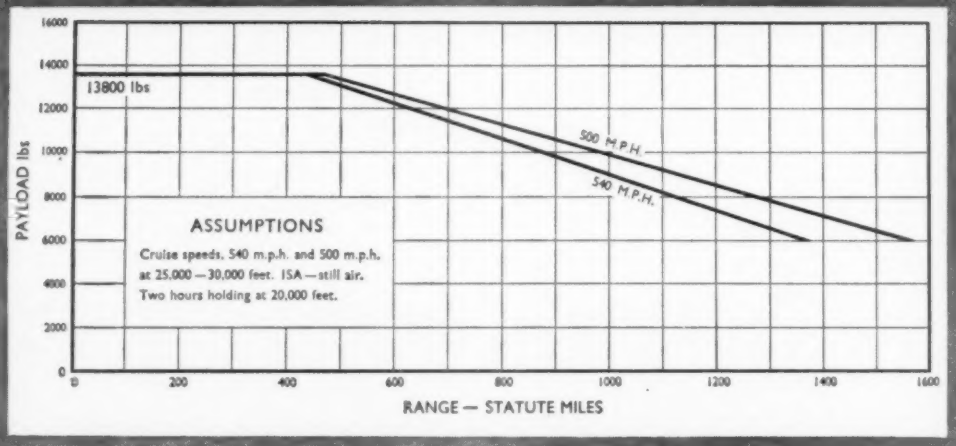
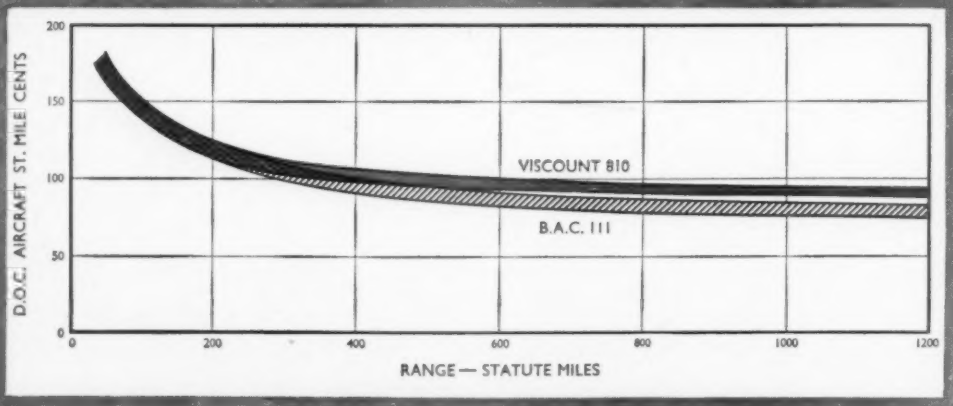


ECONOMICS

These bands cover seven separate methods of costing —ATA (1955), ATA (1960), SBAC and those of four airlines



BRITISH AIRCRAFT CORPORATION

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European Aircraft Industry . . . .

(*Continued from page 548*)

parts, and in many cases have set up European subsidiary companies.

Airframe manufacturers look to operators, both military and civil, for their livelihood and usually have comparatively few customers. Aero-engine companies and equipment suppliers usually cast their net far wider, selling their products to both airframe manufacturers and operators. Also, in the case of aero-engine manufacturers, they tend to be larger companies than airframe builders. This probably explains why aero-engine companies are on the whole more internationally minded than airframe ones, and why British aero-engine companies are firmly entrenched in Europe while the airframe companies are not. It also explains why engines accounted for 52% of the total value of British aeronautical exports last year.

In the past Britain was reluctant to have close links with European aircraft industry. Ten years ago the British aircraft industry was indubitably more powerful than the European industry and it decided not to join the association of European aircraft constructors, AICMA (Association Internationale des Constructeurs de Materiel Aéronautique), which was formed in 1950. This was set up at the instigation of the Union Syndicale des Industries Aéronautiques and since the start France has been its dominant member. Founder members were Belgium, Spain, France, Italy, Norway and the Netherlands. Denmark joined in 1950, Sweden and Switzerland in 1953 and West Germany in 1954.

Its aims are to study matters concerning the development and future of the aircraft industry and to make recommendations which would be desirable for all groups of manufacturers in the Association to follow. It set up standardization, co-ordinating, economic and technical committees. The Association has no executive powers.

Industry Survey

The French industry is by far the largest and most powerful in continental Europe. It employs a total of 90,500 people, as against 287,300 quoted for Britain's industry. The figures cannot be compared exactly, because they are compiled on a different basis. Employment is broken down as follows (British figures in brackets). Airframes, 47,700 (122,500); aero-engines, 15,100 (75,600); equipment, 27,700 (89,200).

France has increased its exports in a dynamic way recently. During the past four years they have made up an increasingly greater part of the industry's total sales, whereas in Britain the proportion of exports has not changed greatly. The output of the French industry has also depended less on military orders. In Britain the military share has remained fairly steady at about 65% of the total, except in 1958.

No direct comparison of output in the two countries can be made, although actual numbers of aircraft and engines produced are available:—

	1958		1959	
	France	U.K.	France	U.K.
Aircraft.. ..	626	850	587	726
Engines.. ..	1,403	2,869	1,490	2,500

These figures may give a misleading impression: light aircraft and small engines make up a much greater part of French output than of British.

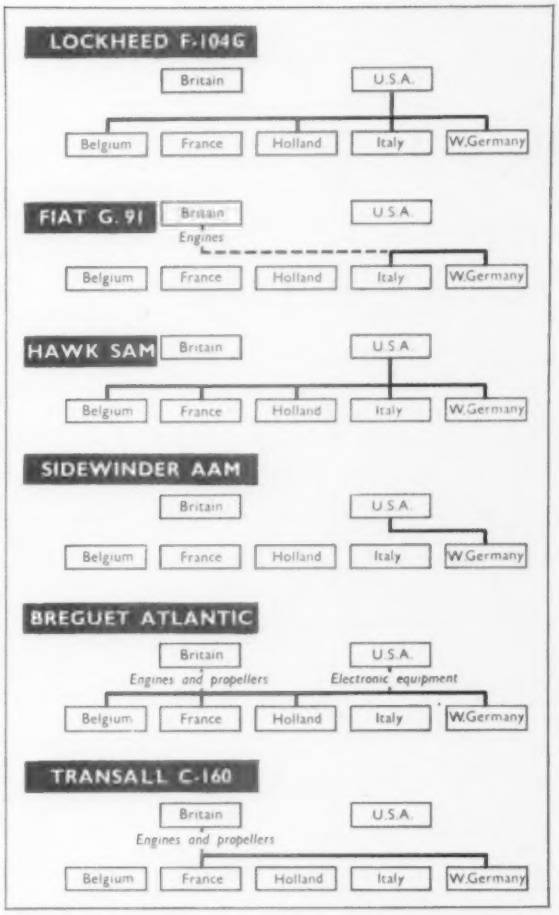
In 1959 French exports were worth £32.8 million, but they were more than doubled last year to £76 million. The comparable British figures were £156.1 million and £142.3 million, equivalent to a decrease of about 9% compared with a French increase of 122%.

The increase in French exports is likely to continue; orders worth £83 million were received in 1960. About 60% were for civil aircraft, mainly Caravelle airliners and Alouette helicopters.

Differences between British and French exports can be seen by breaking down the totals. French exports in 1959 were made up of aircraft, 63%; missiles, 18%; engines, 6%; and equipment, 13%. British exports are aircraft, 43%; engines, 52%; remainder, including missiles, 5%.

France owes much of her export success to the Caravelle, the Alouette helicopter and now the Mirage III, which will be licence-built in Switzerland and Australia.

Despite her membership of NATO and the Common Market, France is pursuing rather a "go-it-alone" policy at the moment, aimed particularly at a strategic deterrent force. Its recently anounced five-year programme calls for the expenditure of



CO-OPERATIVE PROGRAMMES. — Shown here are the countries which share in the joint missile and aircraft programmes of Western Europe. The diagram does not include contributions by British equipment makers.

NF 4,137 million on aircraft, to include 270 Mirage III fighters, 50 Mirage IV strategic bombers, 50 Etendard carrier fighters, 27 Breguet Atlantic anti-submarine aircraft, 80 light transports, 70 Fouga Magister trainers and 220 helicopters. NF 4,928 million (£360 million) will be spent on missiles and nuclear warheads.

Thus France will rely largely on aircraft of her own design, although the Breguet 1150 Atlantic is being developed jointly as a NATO project and the Transall C-160 in co-operation with Germany. She is not involved in the Starfighter programme. In fact, it is said that if France had taken a more flexible attitude, European countries might now be working on a joint programme to build Mirage IIIs rather than F-104G Starfighters.

Next in size to the French industry is the German one, which is said to employ 20,000 people, although this figure must be increasing as the Starfighter programme gets under way. It was not until 1955 that Germany was permitted to manufacture aircraft, and she began by building under licence the Fouga Magister and Piaggio P.149 trainers, the Nord Noratlas transport and the Dornier 27, originally developed in Spain. With the completion of these programmes she is now moving into production of the Fiat G.91 and the F-104G, and working on Breguet Atlantic and Transall C-160 development. She is to play a major rôle in Sidewinder and Hawk missile production.

Development of a supersonic VTOL aircraft is being studied and Germany is obviously interested in developing indigenous types in future after bringing herself up to date by producing contemporary aircraft under licence. Current policy is not to produce civil aircraft except smaller types such as the Dornier 27, which has proved very successful.

Italy has some 9,000 people in her aircraft industry. Its best-known military product is the Fiat G.91, which was adopted as the NATO strike fighter but is being built only in Germany

European Aircraft Industry

GERMAN EXECUTIVES.—Dornier's Do.27 (foreground) has sold well in export markets and more than 400 have been built for the German Services. The twin-engined Do.28 has been derived from it.

as well as in Italy. Fiat is to take part in the F-104G programme. Other important products are the helicopters, mostly of Bell design, which are built by Agusta; the Macchi MB.326 jet trainer; the Piaggio P.149, which has been licence-built in Germany, and the P.166 executive type. During 1959 the industry's sales were worth £16 million, 67% of which was military production.

The aircraft industry of the Benelux countries—Belgium, Netherlands and Luxemburg—employs 10,000 people. Its major companies are Fokker, Aviolanda, Avions Fairey, SABCA and FN. All of these companies are involved in the F-104G programme and Fokker is also taking part in the Breguet Atlantic programme.

The major company is Fokker, which is still producing Friendships in addition to its other commitments. A large stake in Fokker is held by Republic Aviation and joint development of a VTOL project for NATO has been proposed. Dutch aviation exports during 1959 were worth £5.7 million.

The other European country with a major aircraft industry is Sweden. Although it employs only 9,000 people, it has been very successful in producing modern military aircraft of its own design such as the Saab Lansen and Draken. It is doubtful whether Sweden will be able to continue developing advanced types for its own use alone, but the country's past performance has been impressive. Sweden produces Rolls-Royce Avon engines under licence, and is also to manufacture the Hawk and Falcon missiles.

The other traditional neutral of Europe is Switzerland. Largely equipped with British aircraft in the past, Switzerland has now adopted the French Mirage III for production under licence following the abandonment of a Swiss design. The country's aircraft industry employs 2,000 people.

Sheer economics, as well as common defence requirements, have dictated co-operation between European countries in the production of military aircraft and missiles under licence. In many cases the countries do not have the technical resources to develop their own weapons from scratch, and the cost of doing so would be excessive, particularly if production quantities were low. Joint manufacture ensures worth-while production runs.

European Programmes

The most important programme at present is for F-104G production. It involves West Germany, Holland, Belgium and Italy; 949 aircraft are to be built in Europe. Other joint programmes are for production of the Hawk and Sidewinder missiles. The first major collaboration on a European aircraft is for the development and production of the Breguet Atlantic anti-submarine aircraft for NATO countries. France and Germany are jointly developing the Transall C-160 military transport. Details of the F-104G, Atlantic and Transall programmes are given in the articles on the following pages.

Although the United States has provided mutual-aid funds for most of these programmes, its aircraft industry reaps a large return from them. This even applies in cases where weapons are developed in Europe and partly financed by U.S. mutual-aid payments. When this happens, the U.S. Government automatically receives rights for licensed production for military purposes in America. Thus, for example, General Electric is to build the Nord SS-11 anti-tank missile in the U.S. and has production rights for the G-91 and Atlantic. America contributed less than $5 million for SS-11 development, in France.

ITALIAN STRIKER.—Adopted as the NATO light strike fighter, the Fiat G.91 is being produced in Italy and West Germany.

GALLIC FIGHTER.—Dassault's Mirage III is being produced in quantity for the French Air Force and will be built under licence by Switzerland and Australia.

AMERICAN PANACEA.—Lockheed's F-104G Super Starfighter will operate as an interceptor, as a strike aircraft and for reconnaissance duties. West European countries will build 949 of these aircraft.

compared with $38 million for the U.S.-developed Dart anti-tank weapon which has now been dropped.

The F-104G programme is a classic example of the advantage the U.S. industry receives indirectly from mutual aid. European countries were encouraged to adopt the Starfighter by mutual-aid grants of about $220 million. Of this, $140 million went to Belgium, Holland and Italy to induce them to join West Germany in the programme.

But these countries will make payments of about $1,000 million to U.S. companies as a result of the programme, the net inflow to America being about $780 million. In addition, a return will come from the European companies in which U.S. manufacturers hold a stake.

Links with Europe

More and more U.S. companies are buying interests in European manufacturers, as the table opposite shows. It only includes major airframe manufacturers; suppliers of radio, electronic equipment and accessories have interests in many European companies or have formed new jointly owned companies. British manufacturers will continue to watch this trend closely.

American companies are moving into Europe in this way because they want to retain their position in this market as the technical ability of European companies increases and assume greater control of any production under licence. It also helps their diversification programmes as well as giving them a foothold inside European tariff boundaries. It also gives them access to the technical know-how of the European companies in which they hold a stake.

U.S. Company	European Company	U.S. Stake
Cessna	Max Holste	49%
Fairchild	SIAI Marchetti	?
Lockheed	Macchi	?
Republic	Fokker	27.5%
United Aircraft (including Pratt & Whitney and Sikorsky)	SNECMA	10.9%
	Weser Flugzeugbau	43%

This new trend has obviously been accelerated by competition from European companies which have excellent technical ability and the added advantage of being able to develop new aircraft more cheaply than in the U.S. These companies have in some cases been built up as competitors by licensed production of U.S. aircraft.

Many companies still believe in licence agreements with Europe. The more important of these covering aircraft and missiles are summarized below and compared with Anglo-European agreements. The inter-change is not completely one-sided.

The Agreements

Agreements between U.S. airframe and missile manufacturers and European companies include:—

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Cessna—Max Holste—rights for Holste to make Cessna aircraft for Europe and Africa and for Cessna to make and sell Holste types in U.S. and Canada. Douglas—Sud-Aviation—possible manufacture of Caravelle in U.S. and Douglas to represent Sud in certain export markets. Douglas—Piaggio—Piaggio to build Douglas-designed six-seat executive jet transport. Hughes—Swedish Government—licensed production of Falcon AAM.

Lockheed—groups including Aviolanda, Fokker, Avions Fairey, SABCA, Dornier, Heinkel, Messerschmitt, Siebel, Weser, Hamburger, Focke Wulf, Fiat, Aerfer, Piaggio, Macchi, SIAI-Marchetti—licensed production of F-104G Starfighters for the air forces of Belgium, Holland, Italy and W. Germany. Philco—Bodenseewerk Perkin-Elmer (subsidiary of U.S. Perkin-Elmer Co.)—German Co. is prime contractor for European production of Sidewinder AAM.

Raytheon—SETEL [Société Européene de Teleguidage,

GERMAN EXECUTIVES.—Dornier's Do.27 (foreground) has sold well in export markets and more than 400 have been built for the German Services. The twin-engined Do.28 has been derived from it.

as well as in Italy. Fiat is to take part in the F-104G programme. Other important products are the helicopters, mostly of Bell design, which are built by Agusta; the Macchi MB.326 jet trainer; the Piaggio P.149, which has been licence-built in Germany, and the P.166 executive type. During 1959 the industry's sales were worth £16 million, 67% of which was military production.

The aircraft industry of the Benelux countries—Belgium, Netherlands and Luxemburg—employs 10,000 people. Its major companies are Fokker, Aviolanda, Avions Fairey, SABCA and FN. All of these companies are involved in the F-104G programme and Fokker is also taking part in the Breguet Atlantic programme.

The major company is Fokker, which is still producing Friendships in addition to its other commitments. A large stake in Fokker is held by Republic Aviation and joint development of a VTOL project for NATO has been proposed. Dutch aviation exports during 1959 were worth £5.7 million.

The other European country with a major aircraft industry is Sweden. Although it employs only 9,000 people, it has been very successful in producing modern military aircraft of its own design such as the Saab Lansen and Draken. It is doubtful whether Sweden will be able to continue developing advanced types for its own use alone, but the country's past performance has been impressive. Sweden produces Rolls-Royce Avon engines under licence, and is also to manufacture the Hawk and Falcon missiles.

The other traditional neutral of Europe is Switzerland. Largely equipped with British aircraft in the past, Switzerland has now adopted the French Mirage III for production under licence following the abandonment of a Swiss design. The country's aircraft industry employs 2,000 people.

Sheer economics, as well as common defence requirements, have dictated co-operation between European countries in the production of military aircraft and missiles under licence. In many cases the countries do not have the technical resources to develop their own weapons from scratch, and the cost of doing so would be excessive, particularly if production quantities were low. Joint manufacture ensures worth-while production runs.

European Programmes

The most important programme at present is for F-104G production. It involves West Germany, Holland, Belgium and Italy; 949 aircraft are to be built in Europe. Other joint programmes are for production of the Hawk and Sidewinder missiles. The first major collaboration on a European aircraft is for the development and production of the Breguet Atlantic anti-submarine aircraft for NATO countries. France and Germany are jointly developing the Transall C-160 military transport. Details of the F-104G, Atlantic and Transall programmes are given in the articles on the following pages.

Although the United States has provided mutual-aid funds for most of these programmes, its aircraft industry reaps a large return from them. This even applies in cases where weapons are developed in Europe and partly financed by U.S. mutual-aid payments. When this happens, the U.S. Government automatically receives rights for licensed production for military purposes in America. Thus, for example, General Electric is to build the Nord SS-11 anti-tank missile in the U.S. and has production rights for the G-91 and Atlantic. America contributed less than $5 million for SS-11 development, in France.

ITALIAN STRIKER.—Adopted as the NATO light strike fighter, the Fiat G.91 is being produced in Italy and West Germany.

GALLIC FIGHTER.—Dassault's Mirage III is being produced in quantity for the French Air Force and will be built under licence by Switzerland and Australia.

AMERICAN PANACEA.—Lockheed's F-104G Super Starfighter will operate as an interceptor, as a strike aircraft and for reconnaissance duties. West European countries will build 949 of these aircraft.

compared with $38 million for the U.S.-developed Dart anti-tank weapon which has now been dropped.

The F-104G programme is a classic example of the advantage the U.S. industry receives indirectly from mutual aid. European countries were encouraged to adopt the Starfighter by mutual-aid grants of about $220 million. Of this, $140 million went to Belgium, Holland and Italy to induce them to join West Germany in the programme.

But these countries will make payments of about $1,000 million to U.S. companies as a result of the programme, the net inflow to America being about $780 million. In addition, a return will come from the European companies in which U.S. manufacturers hold a stake.

Links with Europe

More and more U.S. companies are buying interests in European manufacturers, as the table opposite shows. It only includes major airframe manufacturers; suppliers of radio, electronic equipment and accessories have interests in many European companies or have formed new jointly owned companies. British manufacturers will continue to watch this trend closely.

American companies are moving into Europe in this way because they want to retain their position in this market as the technical ability of European companies increases and assume greater control of any production under licence. It also helps their diversification programmes as well as giving them a foothold inside European tariff boundaries. It also gives them access to the technical know-how of the European companies in which they hold a stake.

U.S. Company	European Company	U.S. Stake
Cessna	Max Holste	49%
Fairchild	SIAI Marchetti	?
Lockheed	Macchi	?
Republic	Fokker	27.5%
United Aircraft (including Pratt & Whitney and Sikorsky)	SNECMA	10.9%
	Weser Flugzeugbau	43%

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Raytheon—SETEL [Société Européene de Teleguidage,

European Aircraft Industry . . . .

formed by Thompson-Houston DFTH (France) and Finmeccanica (Italy)]—joint production of Hawk SAMs for Belgium, France, Italy, Germany and Holland by companies in these countries with assembly by SETEL. Republic—Sud—production and marketing of Sud Alouette and Djinn helicopters. Sikorsky—Agusta and Sud Aviation—possible joint production of flying-crane helicopter. Sikorsky—Weser—manufacture of WS-64 flying-crane helicopter and licence for S-61. Vertol—Dornier—licence to produce Vertol 107 in Germany.

The more important current agreements between British and European airframe and missile companies are given hereafter.

Armstrong Whitworth—Focke Wulf—Sea Hawk maintenance and repair. Armstrong Whitworth—Nord Aviation—A. W. holds agency rights for SS.10 and SS.11 missiles and production rights for CT.41 target drone. Hawker Siddeley—Nord Aviation—joint work on VTOL strike aircraft. Hawker Siddeley—SEREB—joint space studies. Short Bros. and Harland—Focke Wulf—Seacat missile assessment in Germany and possible production.

This list clearly shows that the U.S. airframe industry has more links with Europe than the British industry. A similar table produced several years ago would have shown Britain in a better light; at that time European countries were building several British military aircraft under licence.

A comparison of aero-engine agreements shows Britain in a better position, and British ancillary suppliers are also doing fairly well in Europe. Aero-engine links are tabulated below.

Sixes and Sevens

Britain is moving towards membership of the Common Market. How will this affect relations between aircraft industries? Experience so far suggests that relations between the Six and Seven do not greatly affect the buying of aircraft where technical and military considerations are pre-eminent, and sheer availability of a suitable product governs its adoption. For example, European countries come to Britain for aero-engines because they cannot get the types they want elsewhere. Then again, Switzerland chose the Mirage III fighter from France, a Common Market country, rather than the Draken which is a product of Sweden, its partner in the Seven.

At present aeronautical imports into Britain from all foreign countries except the Seven pay 17½% duty; the duty between countries in the Seven is 14½%. The Common Market is moving towards abolition of internal tariffs and a common external one; this stage may be reached by 1967. The current position is shown in the next column.

It would appear that the political change of heart involved by Britain joining Europe would be the most important factor in collaboration. Closer collaboration between British and European aircraft industries would be more likely, particularly if defence requirements could be standardized. There appears to be a move towards this at present with the discussion of Anglo-German development of a close-support VTOL fighter based on the Hawker P.1127.

The Future

The trend is towards joint manufacture of European-designed aircraft, and it seems unlikely that there will be many more programmes of the F-104G type in future. But, with the technical ability of European companies increasing, there will be even fiercer competition for military contracts. In the export field the European industry—particularly the French industry—will expand its efforts. France will do all it can to extend the foothold in airline sales which it has established with the Caravelle.

U.S. influence in Europe is on the increase but, instead of simple licence agreements, the modern trend is to buy a stake in European companies. This is an effective way of gaining and retaining both influence and business at a time when European companies are achieving technical priority with those of Europe. Agreements between European companies for joint production are likely to be extended; only in this way can Europe produce economically the weapons it needs for defence.

DUTIES ON AIRCRAFT

	Rate of duty *ad valorem* c.i.f. As at 1.1.57		Current Rate of duty *ad valorem* c.i.f.	
	From C.M. Countries	From Other Countries	From C.M. Countries	From Other Countries
FRANCE				
Flying machines, gliders and kites of an unladen weight of more than 1,500 Kg. ..	20%	20%	Exempt	16.8%—18.3%*
Helicopters of an unladen weight of 1,500 Kg. or less	20%	20%	Exempt	17.6%
Aerial Targets weighing 1,500 Kg. or less	20%	20%	Exempt	18.3%
Other flying machines, gliders or kites	20%	20%	14%	17.6%—18.3%
BENELUX				
Flying machines without mechanized propulsion	10%	10%	7%	11.4%
Powered flying machines:				
(a) intended for use by international airlines ..	Exempt	Exempt	Exempt	2.9%—3.6%†
(b) intended for other uses	10%	10%	7%	10%—11.2%†
GERMANY				
Powered flying machines, imported with or without power unit	Exempt	Exempt	Exempt	2.9%—3.6%
Other flying machines ..	20%	20%	14%	14.7%
ITALY				
Non-powered flying machines	21%	21%	14.7%	18.96%
Powered flying machines:				
Up to 1,500 Kg. weight ..	22%	22%	15.4%	19%
1,500—5,000 Kg. weight ..	18%	18%	12.6%	15.96%—16.2%
More than 5,000 Kg. weight	13%	13%	9.1%	12%—14%

* Duty is suspended on imports of helicopters over 2,000 Kg. weight (until 31.12.63); on imports of fixed-wing powered aircraft of 2,000—15,000 Kg. (until 31.12.63); and on imports of fixed-wing aircraft over 15,000 Kg. weight (until 31.12.66).

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GERMANY imposes a Turnover Equalization Tax of 4%—6% of the duty-paid value.

ITALY levies an administration fee of 1% of the c.i.f. value, a General Turnover Tax of 3.3% of the gross landed value, and a Compensatory Tax of 6.5% of gross landed value.

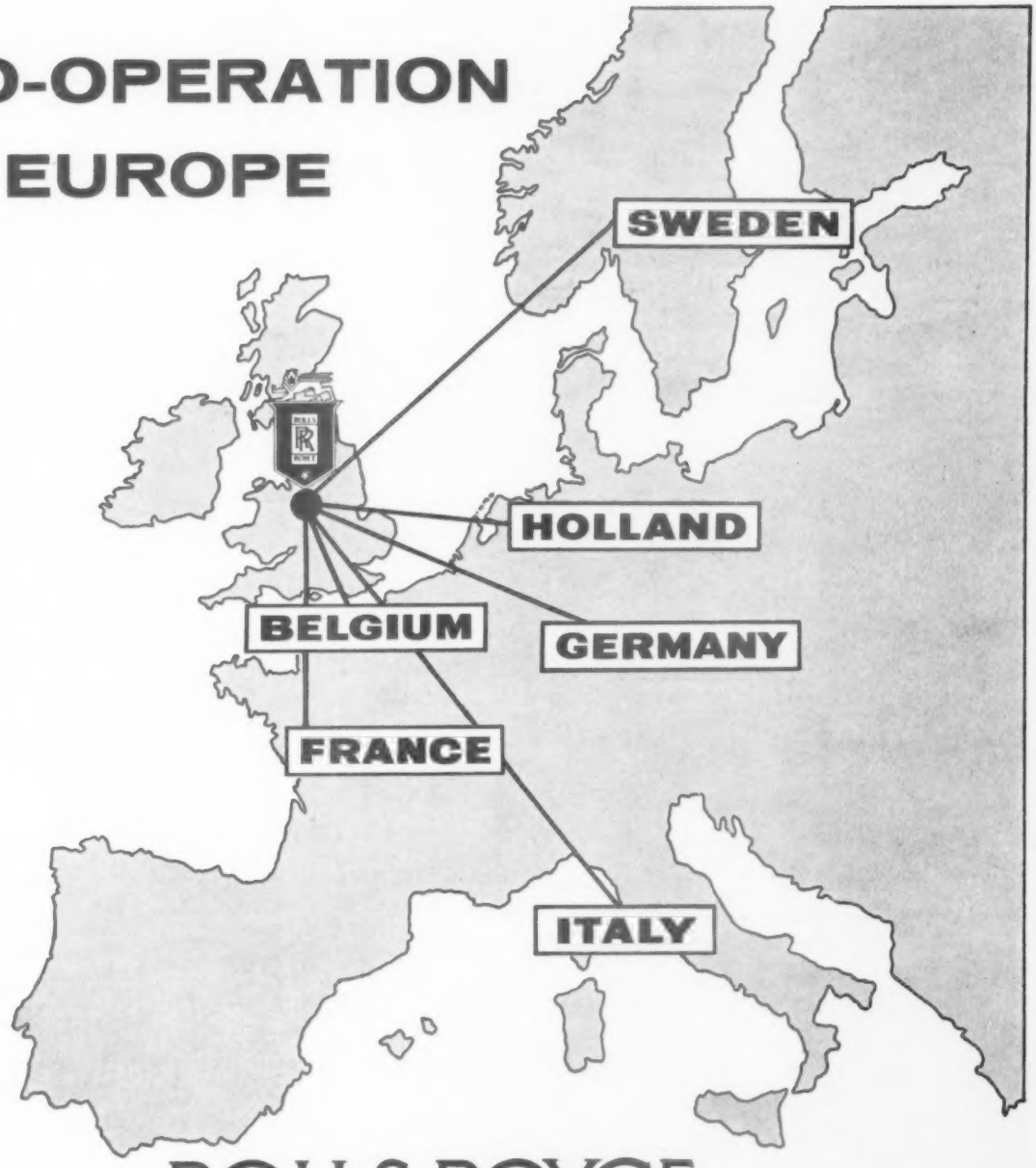
IMPORT DUTIES.—Current duties for aeronautical exports to and between the Common Market countries are compared with those which existed before the Treaty of Rome came into force. Another revision of tariffs is due at the end of this year.

MAJOR AERO-ENGINE AGREEMENTS WITH WEST EUROPEAN COMPANIES

BRITAIN			UNITED STATES		
U.K. Company	European Co.	Coverage	U.S. Company	European Co.	Coverage
Blackburn Engines	Turbomeca ..	Manufacture and sale of Turbomeca-based engines.	Continental ..	Turbomeca ..	U.S. licence for Turbomeca engines.
Bristol Siddeley Engines	Fiat ..	Production of B.S. Orpheus for G.91.	General Electric..	BMW ..	Production of J79 turbojet for F-104G.
Bristol Siddeley Engines	Klockner-Humboldt-Deutz		General Electric..	Fiat ..	
Bristol Siddeley Engines	Piaggio	Production of B.S. Viper 11.	General Electric..	FN ..	
Bristol Siddeley Engines	Svenska Flygmotor	Technical collab. on ramjets.	Lycoming ..	BMW	Production of GO-480 piston engine.
Rolls-Royce ..	M.A.N. Turbomotoren	Joint development of RB.153 small supersonic turbojet.			
Rolls-Royce ..	Hispano-Suiza ..	Production of Tyne turboprop for Transall and Atlantic.	Lycoming ..	Klockner-Humboldt-Deutz	Licensed sale rights in Europe for T53 and T55.
Rolls-Royce ..	Svenska Flygmotor	Manufacture of R.-R. Avon for Saab Lansen and Draken.	Lycoming ..	Piaggio	Production of piston engines.
			Pratt & Whitney	SNECMA ..	Licensed manufacture and overhaul of P. & W. engines.
			Rocketdyne ..	SEPR	Rocketdyne engines in Europe, SEPR engines in U.S.

Note: Table does not include British–U.S. engine agreements; most important of these are de Havilland Engine's licence for production of the General Electric T58 as the Gnome; the agreement with Rolls-Royce for licensed production of Continental piston engines; the Rolls-Royce agreement with Rocketdyne relating to development of rocket engines for Blue Streak; and the 50% stake held by Aerojet General in Bristol Aerojet.

CO-OPERATION IN EUROPE



ROLLS-ROYCE

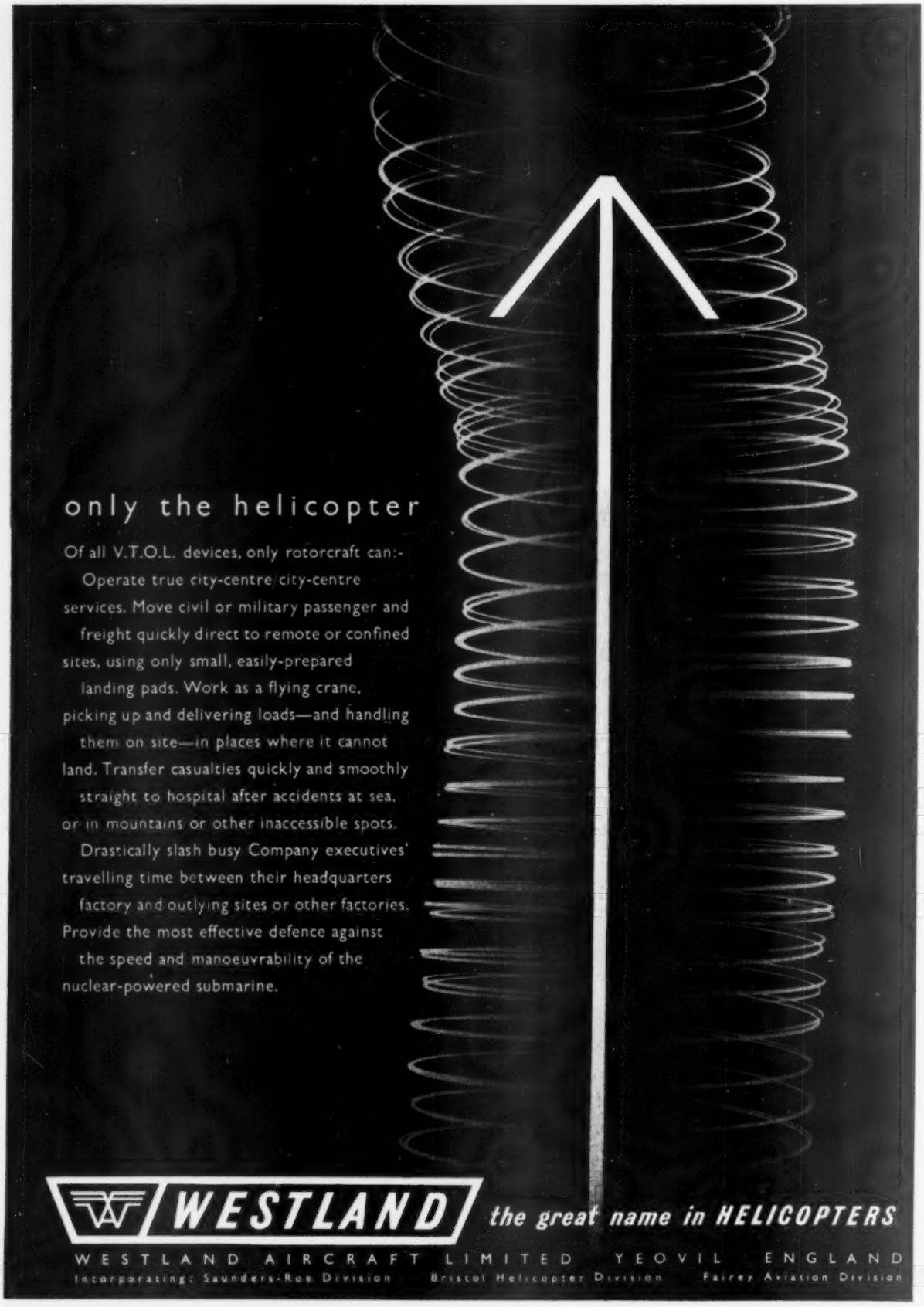
GAS TURBINES

Rolls-Royce co-operate closely with many aircraft and engine companies in Europe. Rolls-Royce engines have been manufactured by European companies in quantity and the association continues with the following companies :—

Alfa-Romeo · Breguet · Dassault · Fabrique Nationale · Fokker · Hispano-Suiza · M.A.N. Nord Aviation · S.A.A.B. · Sud Aviation Sudring · Svenska Flygmotor · Weser Flug

ROLLS-ROYCE LIMITED · DERBY · ENGLAND

AERO ENGINES · MOTOR CARS · DIESEL AND PETROL ENGINES · ROCKET MOTORS · NUCLEAR PROPULSION



only the helicopter

Of all V.T.O.L. devices, only rotorcraft can:-

Operate true city-centre/city-centre services. Move civil or military passenger and freight quickly direct to remote or confined sites, using only small, easily-prepared landing pads. Work as a flying crane, picking up and delivering loads—and handling them on site—in places where it cannot land. Transfer casualties quickly and smoothly straight to hospital after accidents at sea, or in mountains or other inaccessible spots.

Drastically slash busy Company executives' travelling time between their headquarters factory and outlying sites or other factories. Provide the most effective defence against the speed and manoeuvrability of the nuclear-powered submarine.

WESTLAND *the great name in HELICOPTERS*

WESTLAND AIRCRAFT LIMITED YEOVIL ENGLAND

Incorporating: Saunders-Roe Division Bristol Helicopter Division Fairey Aviation Division

European Aircraft Industry . . . .

Breguet 1150—A Co-operative Venture

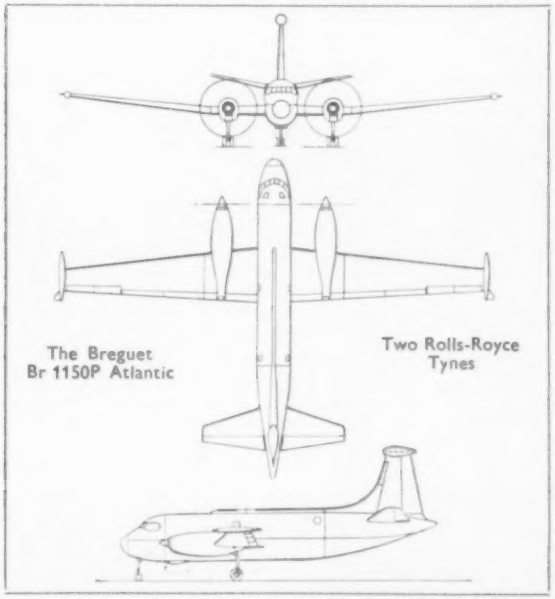
NEARING completion in the Toulouse assembly plant of S.A. des Ateliers d'Aviation Louis Breguet, and scheduled to make its first flight in October this year, is the first prototype of the Br 1150 Atlantic twin-engined anti-submarine and reconnaissance aircraft for NATO. Conventional enough in design and performance, the Atlantic is a milestone in aircraft development in being the first completely co-operative product of the European aviation industry. Although overall responsibility for the design and development is vested with Breguet, which with its current Alizé production is one of the most experienced European companies in handling turboprop anti-submarine types, detailed design and production are distributed additionally between Sud-Aviation, for the outer wings, SABCA and Fairey Aviation in Belgium for installation of the British Rolls-Royce Tyne powerplants, Fokker in the Netherlands for the centre-section and nacelles, and Dornier in Germany for the rear fuselage and tail.

Having specified the overall shape of the Atlantic design, and the type of structure to be used (which makes liberal use of Breguet's own bonded honeycomb techniques), the co-ordinating company in France left such details as the size of ribs and the pitch of stiffeners to be decided by the drawing offices of the other companies. The Atlantic is thus a truly international design, as well as constructional venture, and is a successful vindication of the original NATO concept for its development.

This arose in 1958 when the need for a replacement for the veteran Lockheed P2V Neptunes of the NATO maritime reconnaissance squadrons became apparent. The Neptune is still in service with the U.S. Navy and with many of the NATO countries in Europe to which it had been supplied under M.D.A.P., but for its replacement a divergence of requirements became evident. The U.S.N. demands a greater range for current maritime operations than is the case among the NATO countries, where the emphasis is more on coastal than deep-water patrol and for a smaller and less expensive aircraft.

A general operational requirement for such a type was therefore drawn up early in 1958 by NATO planning staffs, after which a group of M.R. specialists was appointed from France, Germany, the U.S., the U.K., Canada and the Netherlands to frame more specific proposals. Each country was represented by a tactical and an engineering representative, who eventually framed a specification for the NATO maritime reconnaissance type for distribution among the European industry.

The specification was unusual in including a development and production requirement from at least two companies in different countries. In anticipation of the joint development clause, Breguet concluded an agreement in May, 1958, with Sud-Aviation, Fokker, Dornier and Avro in Britain, to form a consortium to design and build between them any of the selected projects from among their members. Each company was entitled to submit a design study in accordance with the NATO specification, the winner to assume overall authority, and the design and production work to be spread among the other members.



By Jne. 28, 1958, some 18 designs from 26 companies representing eight different countries had been submitted to NATO for evaluation. The U.S. aircraft industry had entered late into the competitive arena, with projects from Martin, Douglas, Lockheed and Grumman, while from the Continental consortium, designs were submitted by all the participating companies except Fokker. Although no particular powerplant, or indeed the number of engines, had been specified, the framing of the specification indicated a twin-engined configuration. To meet the performance, high power and light weight necessitated installation of turboprops, and of the available units, the Rolls-Royce Tyne was a natural choice, in view of its stable twin-spool layout and low s.f.c. for long-range patrolling low down.

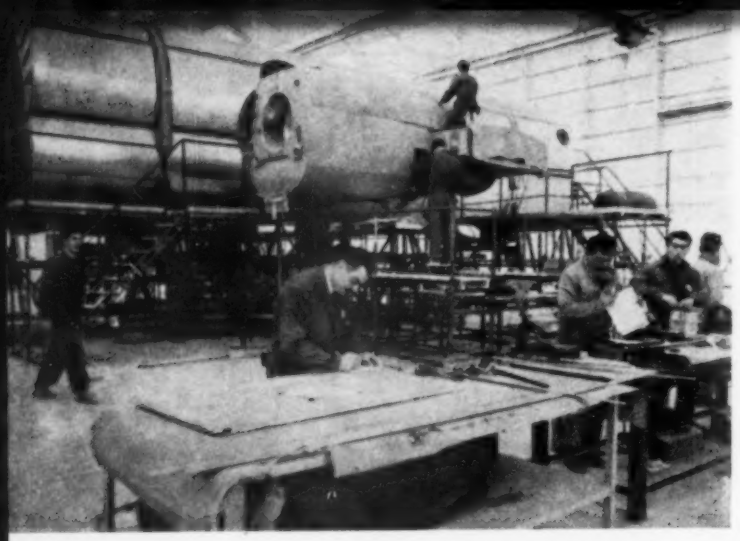
Most of the European projects therefore specified the Tyne, and nearly all the designs submitted were for twin-engined land-planes. The Dornier company submitted the only flying-boat, but this project was the first to be eliminated, since virtually no facilities for these craft now exist in Europe, and the designs are considered to have no rough-water capability.

Details of all the projects were tabulated, and criteria established for the process of elimination. All decisions from the standing group had to be unanimous for a successful conclusion of international development to be reached, and by September, 1958, the choice had been narrowed by mutual agreement to three projects, all Tyne-powered. These had been submitted by Avro, Breguet and Nord, and after further investigation of the manufacturing aspects of these companies, only the Avro and Breguet projects were left for final evaluation. In this, the NATO group was assisted by the U.S. Navy BuAer (now Bureau of Weapons), which among other things investigated the safety aspect of a twin-engined maritime aircraft.

In the final selection, the Breguet design was selected because of a number of points considered to increase its suitability for the NATO job, including a growth factor for later development, accommodation for a wider variety of equipment, and a multi-mission capability. As it happened, by the time the Breguet design had finally been chosen, on Dec. 31, 1959, the R.A.F. requirements for which the Avro design had been primarily tailored, changed with the extension of planned life of the Coastal Command Shackletons because of developments in the electronic detection field, so that Britain was no longer interested in procuring a NATO aircraft.

Equally, there was no point in developing a parallel design to the NATO choice, so Avro therefore withdrew from the Continental consortium. Britain was assured of continued participation in the project, since the Tyne was the selected powerplant for the winning Breguet design. The way was left open for Britain to rejoin the consortium more actively should conditions change, and the U.K. representatives on the standing group were among those who voted unanimously for the Breguet design at the end of 1958. This decision was endorsed unanimously by the 15-nation NATO armaments committee early in 1959, and detailed design started forthwith.

From the financial point of view, the Atlantic project was to be distributed among those countries contributing towards its cost, and these were primarily France, Netherlands and Germany. Some financial assistance was also obtained from



Due to fly in October this year, the prototype Breguet Atlantic was taking recognizable shape when this photograph was taken at Toulouse-Blagnac some months ago. Features visible include the "double-bubble" fuselage and big nacelles for the Tynes.

the U.S. under M.W.D.P., and Belgium offered to contribute in return for a share of the constructional programme. The only Belgian military requirement for an aeroplane like the Atlantic was for the former Congo colonies, there being no North Sea or Channel commitment.

The Atlantic in Detail

As finally approved, the Breguet Br 1150P Atlantic is a medium-range NATO maritime patrol aircraft, powered by two 6,000 e.h.p. Rolls-Royce Tyne RTy 20 turboprop engines driving four-bladed de Havilland airscrews of 16 ft. diameter. To combat fast-cruising nuclear-powered submarines it is required to have a high en route cruise performance, which necessitates pressurization for operation at the optimum altitude. For long-endurance search on station, it requires good low-speed handling characteristics, plus a large useful load for fuel, a crew of 12 and extensive navigation and detection equipment.

Although an entirely new design, the Atlantic takes the well-tried Neptune formula several stages further, while retaining a generally similar layout. It rectifies some of the shortcomings of the older aircraft in such features as greatly improved comfort and crew space for patrols of up to 18 hr. endurance, and the use of a "double bubble" fuselage section provides the maximum accommodation for equipment, weapons and personnel while simplifying pressurization problems.

Fuselage design and production are the responsibility of Breguet, which as the overall co-ordinating agency also issues common standards for the project and supplies the contracting companies with strength data. The locally completed detailed design work is integrated and approved at regular joint meetings of the Atlantic steering committee, on which the five countries concerned are represented. This committee is assisted by working groups to advise on such aspects as equipment, maintenance, etc., where again all decisions must be unanimous.

They are then approved by the steering committee and, although the means by which decisions are finally secured may appear devious, the total penalty for the first successful application of co-operative industrial effort in European aviation is reckoned to be only two or three months in delaying the first flight of the Br 1150P, or prototype Atlantic. In compensation, where such items as equipment are concerned, the five participating countries plus the U.S. and Canada have each made their latest items and techniques available, so that the best of international modern practice is incorporated in a single design.

In the case of the vital electronic search and detection equipment, the Atlantic started out with the excellent French radar and associated apparatus, but the United States has also made available some of its very advanced anti-submarine gear. It is naturally impossible to itemize the equipment carried by the Atlantic, but its very advanced detection apparatus includes long- and medium-range sets. It also carries classification and localization short-range equipment. Detection is undertaken by high-power radar and a very complete sonobuoy system.

Advanced and accurate navigational equipment delivers, continuously and without reference to any external means, the position of the aircraft with particular reference to its sonobuoy patterns. The navigation information and detection data are fed into large-size displays and electronic computer centres which give the operators an overall view of the tactical situation.

LEADING PARTICULARS—Breguet Br 1150P Atlantic

DIMENSIONS.—Span, 37.9 m. (124.3 ft.); length, 27.25 m. (89.4 ft.); height, 10.8 m. (35.4 ft.); wing area, 120 sq. m. (1,293 sq. ft.).

WEIGHTS.—Take-off maximum, 41,000 kg. (90,400 lb.).

PERFORMANCE.—Maximum speed, 615 km./hr. (334 knots); patrol speed, 320 km./hr. (170 knots); ceiling, 10,000 m. (33,000 ft.); range, 9,000 km. (5,000 n.m.); endurance, 12-18 hr.

Navigation, search and attack in modern anti-submarine aircraft are largely automatic, and the large crew of the Atlantic are presented with the maximum amount of information necessary for an evaluation of the current situation and the rapid solution of the most complex tactical problems.

The range of anti-submarine weapons available for carriage by the Atlantic has been published as all the normal NATO conventional armament or bombs, plus 385-lb. American or French depth charges, HVAR rockets with solid penetration heads, homing torpedoes, including electric acoustic torpedoes of the Mk. 43 Brush or LK.4 type, and air-to-surface missiles on underwing pylons for the attack of surface traffic, or, with nuclear warheads, on submerged submarines.

To achieve the necessarily high ratio of useful load to the 90,000 lb. gross weight, the wing torsion-boxes and fuselage shell of the Atlantic made extensive use of the Breguet bonded-metal honeycomb, which was used on another NATO project, the Br 1001 Taon lightweight fighter, and also features in the STOL Br 940 and 941 designs. This system of construction is very light for its strength, is cheaper to manufacture than the large number of parts it replaces, and has excellent fatigue properties. In the wing construction, it permits the use of integral tanks with very clean internal surfaces, thereby avoiding the problem of trapped and unusable fuel.

Bonded honeycomb techniques are also used by the other contracting companies for components of the Atlantic, the material having been developed in the first place in conjunction with Sud Aviation, while Fokker is experienced in the use of metal-to-metal bonding with Redux in the Friendship.

For short-field operation, the Atlantic has very large area-increasing flaps, and all three legs of the nosewheel undercarriage carry dual tyres to reduce the bearing loads.

The Atlantic was tooled up for production before either of the two prototypes were scheduled to fly, and the necessary jigs have been almost completely laid down. Some reservations are being made in case slight modifications should be found necessary after the first prototype trials during 1962, but Atlantic production is already in hand at Amsterdam (Fokker), Münich (Dornier), Courbevoie (Sud Aviation), and Villacoublay, Toulouse and Biarritz (Breguet). The Belgian component of the consortium, ABAP (Association Belge pour l'Avion Patrouilleur) which includes Fabrique Nationale, Avions Fairey and SABCA, will participate at a later stage.

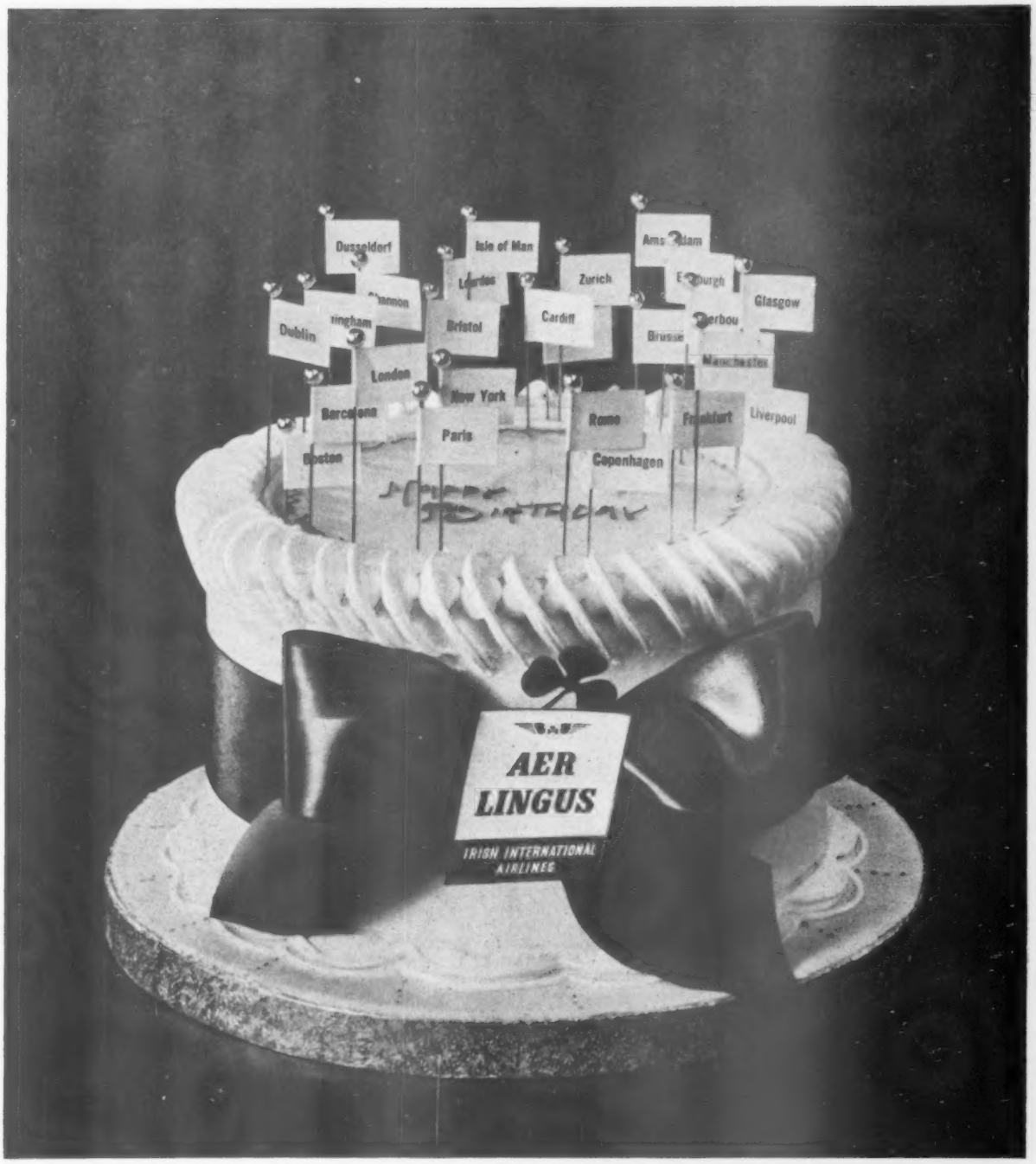
FN in Belgium, together with the German MAN company and Hispano-Suiza in France, may eventually build the Tyne under licence for the Atlantic. Rolls-Royce have made available three Tyne powerplants for the prototype Br 1150P without charge, and with them have been supplied the auxiliary drive gearboxes by Rotol. These are similar to those on the Vanguard, although much more heavily loaded because of the Atlantic's extensive electronic equipment, and to conform with the requirement for full mission capability on one engine.

The problem of marrying equipment from several different countries in a single airframe has been simplified by the common use of the metric system by all except the British powerplant group. In addition to an interest in the Atlantic's powerplants, the French Hispano company is also responsible for the undercarriage design and production.

Credits have been allocated by the three countries principally involved in the Atlantic project—France, Germany and the Netherlands—for research and production, and also for procurement by the national forces, which will be the navy in each case. The first firm contracts have been placed by the French, who in the recently ratified five-year defence plan or "*loi programme*," specified the procurement of 27 Atlantics.

Meanwhile, the second prototype Atlantic is rapidly taking shape alongside the first in the new assembly hall at Toulouse-Blagnac, and the entire programme, in keeping well up to schedule, is proof of the remarkable achievement in co-operation by all concerned with this historic first joint venture of NATO. Particular credit is naturally due to Breguet, for the effective co-ordination the company has applied to a most complex technical problem. Of the many individuals involved, mention must be made of M. Georges Ricard, technical director of Société Breguet and the key man in the Atlantic project, and M. Jean Barge, Breguet director of production who has to put all the pieces together.

The success of the Atlantic as a co-operative effort may be measured by the fact that eventually, the components for each aircraft will come from more than a dozen centres in half as many countries. To its political and economic significance, the Atlantic union takes on a new meaning of technical triumph.—JOHN FRICKER.



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WHAT'S DOING AT MANCHESTER?

Why is Manchester so proud of its Airport?

Owned by the Manchester Corporation, it is the largest municipal aerodrome in Great Britain, linking the city and its surroundings—which, within a radius of fifty miles, embrace the most heavily industrialised area in the world—with more than fifty cities and towns in North America, Europe and the United Kingdom. Manchester Airport is a first-class example of municipal enterprise on an international scale.

How long has it been Corporation-controlled?

Since it was first opened on June 25, 1938. After the war the Ministry of Civil Aviation intended to purchase the Airport but Manchester Corporation considered that it was better suited to understand and further the aeronautical aspirations of the area. This opinion was backed by years of experience in operating a municipal airport, first at Wythenshawe in 1929, then at Barton and finally at Ringway, the present location. The Corporation won its point.

What about current development?

The main runway has been extended and construction of the magnificent new terminal which began in October 1957 is due for completion this year, as is the installation of an Esso hydrant refuelling system. This will be the first major development of its kind in the United Kingdom.

Why have hydrant refuelling?

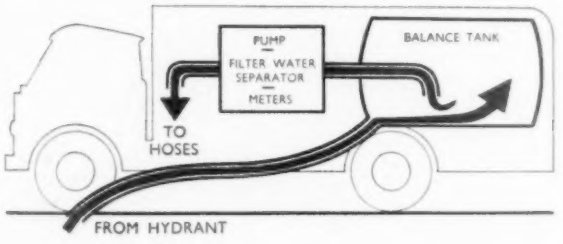
Thirsty jet airliners with a vast capacity for fuel; apron space at a premium as traffic increases; and the constant demand for quick turn-round which is the secret of economy. All these factors contribute to the pressing need for safe, efficient fuel service fast, however great the requirement. One of the answers is hydrant refuelling. And at Manchester Airport, the fact that it handles a considerable proportion of transit traffic, coupled with the compact design of the new terminal area makes hydrant refuelling the ideal choice.

What's all this excavation work?

The photograph shows part of the pipelines of the hydrant system at Manchester and the site of the shock-alleviating chambers—essential items in this kind of system to cope with the problem of hydraulic shock. At Manchester the function of these units is supplemented by the use of Hydrafuellers—an Esso invention which will ensure that the hydrant system at this Airport will set a new standard for safety and efficiency in operation and economy in installation.

And just what is a Hydrafueller?

Esso's new Hydrafueller is a servicing vehicle which consists principally of a balance tank with a pump, filters, bypass valves and fuelling hoses. The diagram shows how it works.



Fuel from the hydrant flows into the balance tank at a rate governed by the hydrant pumps and controlled by the float and slow-closing valve. The pump on the vehicle takes its suction from the tank and delivers fuel to the aircraft through a short length of hose. Thus the Hydrafueller completely isolates the aircraft from the risk of hydraulic shock from the hydrant line. This is but one example of Esso's original thinking—keeping an eye on the future as well as meeting current demands.

What are the prospects at Manchester?

The passenger and freight potential in the area served by the Airport is enormous. Within a fifty-mile radius there are all the cotton-manufacturing towns, the whole of the Yorkshire woollen district, the Potteries, Sheffield, Liverpool and part of the manufacturing area round Derby. Manchester is determined to match this impressive air traffic potential by airport services which will compare favourably with those provided by any other major airport in the world. And in this bold endeavour Esso is equally determined to play its full part. In the future as in the past it will continue to provide safe, swift fuel service at Manchester of a standard that is second to none.

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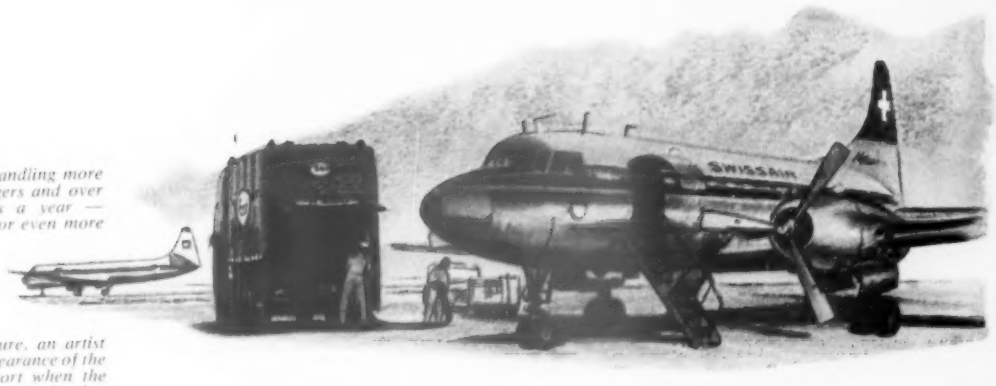
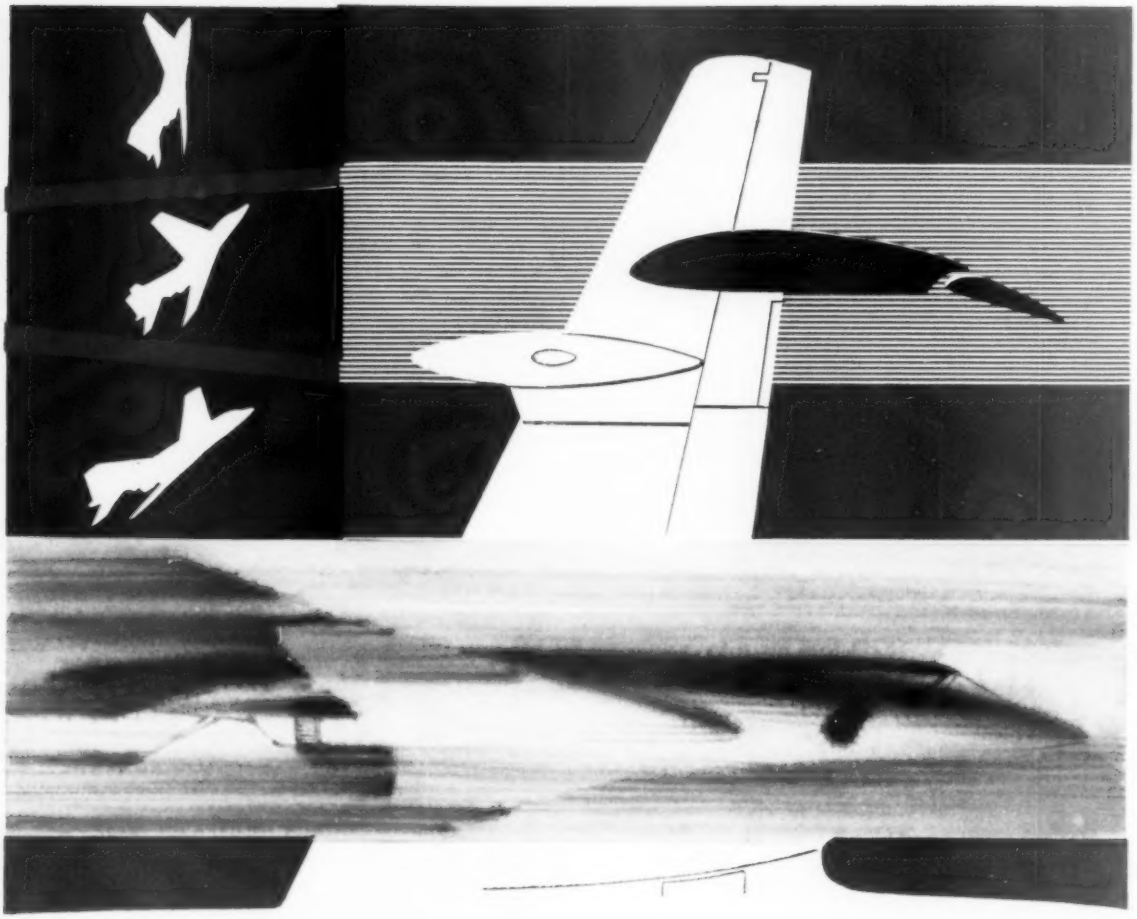


Already a busy airport — handling more than half a million passengers and over 32,000 aircraft movements a year — Manchester is gearing up for even more business.

Looking into the near future, an artist emphasises the "clean" appearance of the apron at Manchester Airport when the hydrant fuelling system is completed.

AEI POWER FOR FLIGHT



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Super Starfighters in NATO Countries

SO far as air strength in Continental Europe is concerned, one of the most important aircraft is the multi-mission Lockheed F104G for the West German and other NATO air forces. This remarkable aeroplane is not, of course, particularly new as a type—Starfighters have been in service in single- and two-seat versions for the U.S.A.F. for some three years and they are no longer in production on that particular score. However, in its latest guise—in which it goes by the name of Super Starfighter—it embodies a number of modifications and refinements intended specifically to befit it for a multi-purpose rôle, for which there is a firm requirement among NATO forces. The only outward and visible sign which distinguishes the Super Starfighter from its predecessors is a larger fin and rudder, with about 25% more area, made necessary by the need to undertake ground-attack duties and the consequent demand for precise and positive directional control at all speeds.

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Later revised plans and the decision of Belgium and Holland to equip their air forces with the same type, and Italy's expressed desire to join the Starfighter "club," have led to three more production programmes and these have added 739 more aircraft to the total. Of these, the impressive number of 375 are being built by a northern group comprising the West German concerns of Hamburger, Weser and Focke-Wulf and the Dutch companies Fokker and Aviolanda. Another 182 are being produced by a western group composed of Avions Fairey and SABCA in Belgium and the Italian Fiat company; and a similar quantity is to be built in an Italian group headed by Fiat and drawing on some assistance from Avions Fairey and SABCA.

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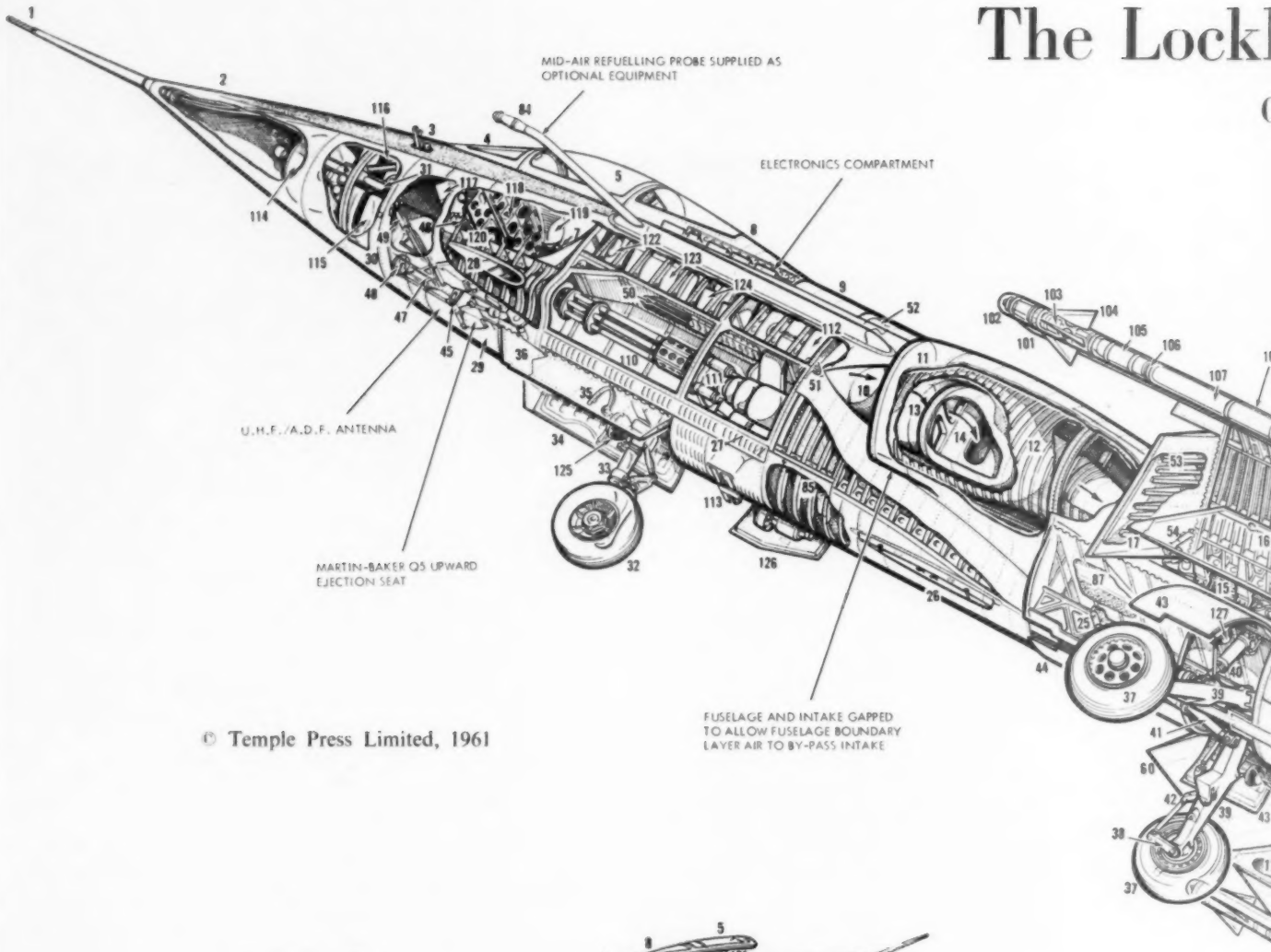
As a piece of military equipment the principal interest

Two-seat F-104F Starfighters are being used by the Luftwaffe for familiarization before delivery of F-104Gs.

The Lockh


MID-AIR REFUELLING PROBE SUPPLIED AS OPTIONAL EQUIPMENT
ELECTRONICS COMPARTMENT
U.H.F./A.D.F. ANTENNA
MARTIN-BAKER Q5 UPWARD EJECTION SEAT
FUSELAGE AND INTAKE GAPPED TO ALLOW FUSELAGE BOUNDARY LAYER AIR TO BY-PASS INTAKE

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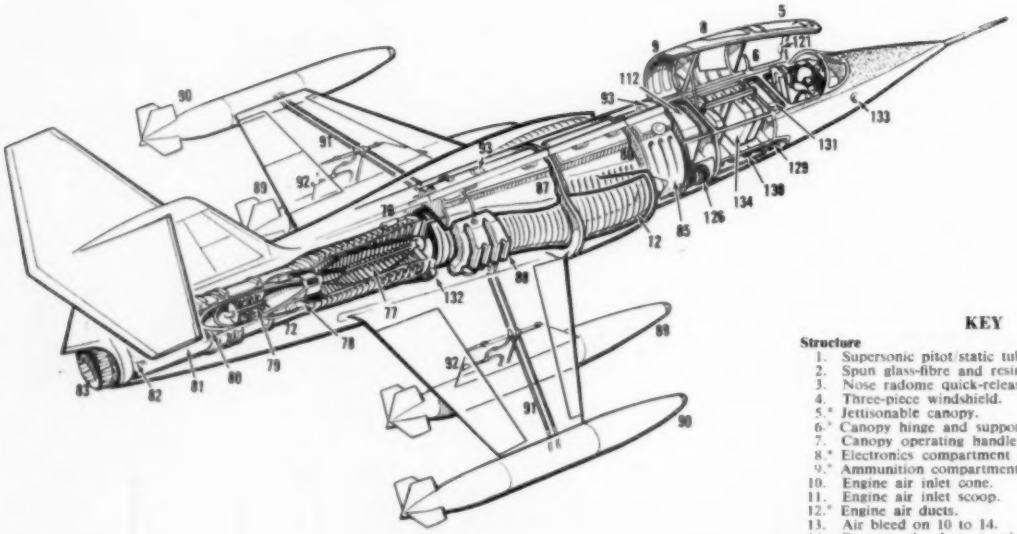


KEY

Structure

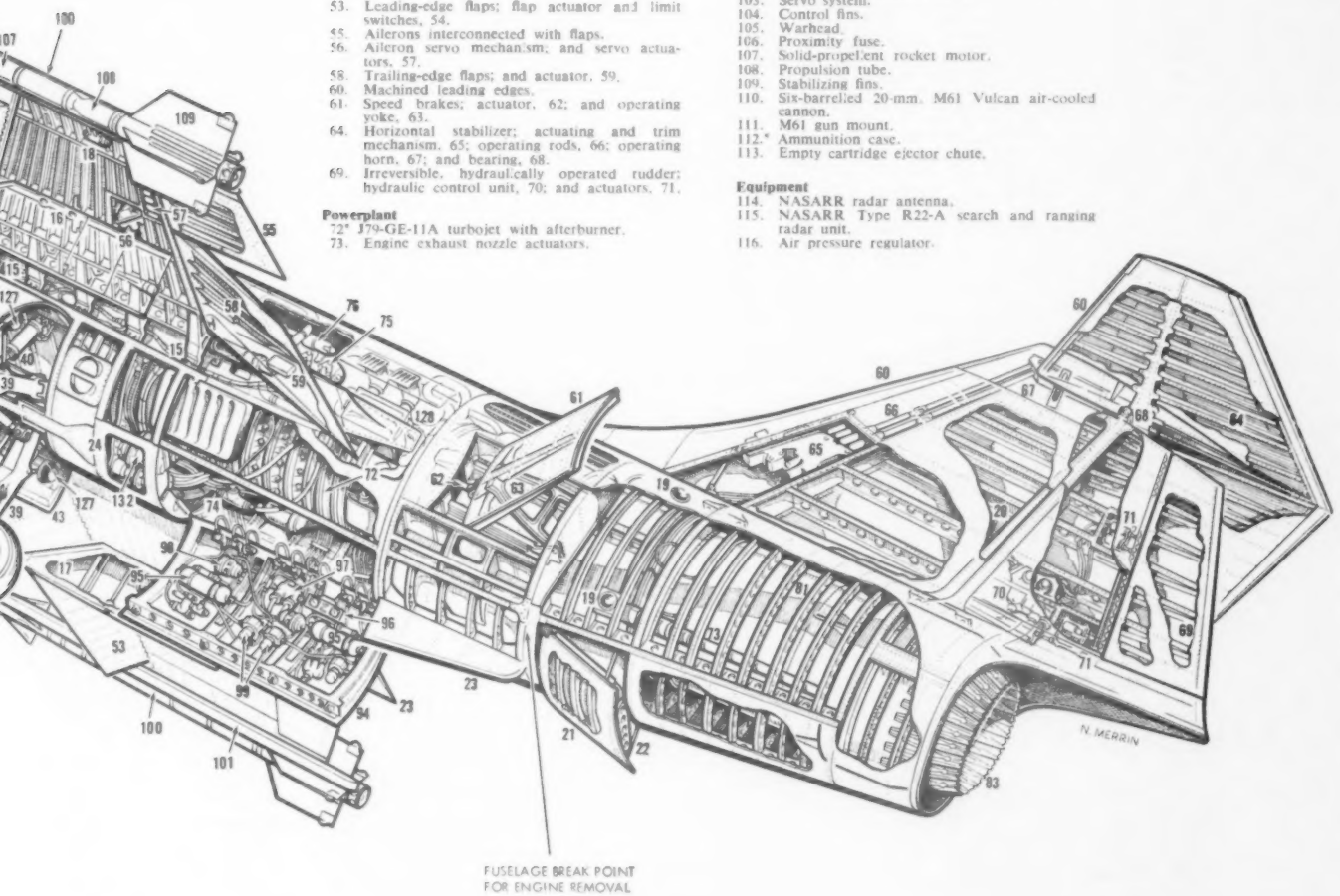
1. Supersonic pitot/static tube.
2. Spun glass-fibre and resin nose radome.
3. Nose radome quick-release latches.
4. Three-piece windshield.
5. * Jettisonable canopy.
6. * Canopy hinge and support.
7. Canopy operating handle.
8. * Electronics compartment cover.
9. * Ammunition compartment cover.
10. Engine air inlet cone.
11. Engine air inlet scoop.
12. * Engine air ducts.
13. Air bleed on 10 to 14.
14. By-pass air duct supplying cooling air to engine and afterburner.
15. Wing attachment fittings.
16. Wing pylon support rib.
17. Wing pylons, fuel tanks or external stores.
18. Wing-tip tank latch and release mechanism.
19. Upper and lower navigation lights.
20. Specially strengthened and enlarged vertical stabilizer.
21. Drag 'chute door, housing 18-ft. braking canopy.
22. Drag 'chute gate.
23. Two-piece ventral fin.
24. Generator access
25. Forged keelson landing gear leg
26. Centreline exter 2,000-lb. capacity
27. Air exit louvres f
28. Blast tube for Me
29. Pilot's compartme
30. Air outlet for coc ment.
31. Nose radome sup easy access to N

Landing Gear

32. Forward retractin
33. Nose landing-gear
34. Nose landing-gear
35. Door-operating m
36. Runway barrier t
37. Main landing whe
38. Main-wheel axle
39. Main landing gea dampers. 40 actu
42. Positioning linkag stowed positi
43. Main landing-ge returning to al wheels down. 44

ckheed F-104G Super Starfighter

One General Electric J79-GE-7A turbojet of 15,800 lb. s.t. with reheat



Flight Controls and Surfaces
45. Pilot's control column.
46. Rudder pedals.
47. Control stick push-rod and centering mechanism.
48. Aileron control cable quadrant.
49. Elevator torque tube and bellcrank assembly.
50. Flight control cables; bellcranks, 51; and dusting, 52.
53. Leading-edge flaps; flap actuator and limit switches, 54.
55. Ailerons interconnected with flaps.
56. Aileron servo mechanism; and servo actuators, 57.
58. Trailing-edge flaps; and actuator, 59.
60. Machined leading edges.
61. Speed brakes; actuator, 62; and operating yoke, 63.
64. Horizontal stabilizer; actuating and trim mechanism, 65; operating rods, 66; operating horn, 67; and bearing, 68.
69. Irreversible, hydraulically operated rudder; hydraulic control unit, 70; and actuators, 71.

Powerplant
72.* J79-GE-11A turbojet with afterburner.
73. Engine exhaust nozzle actuators.
74. Throttle control assembly.
75. Variable stator operating mechanism.
76.* Variable stator actuator.
77.* Seventeen-stage compressor.
78.* Ten combustion canisters.
79.* Three-stage reaction turbine.
80.* Flameholder ring.
81.* Afterburner section.
82.* Primary jet nozzle flaps.
83.* Secondary jet nozzle flaps.

Fuel System
84. Mid-air refuelling probe.
85.* Auxiliary fuel cell.
86.* Forward main fuel cell.
87.* Aft main fuel cell.
88.* Left- and right-hand saddle tanks.
89.* 162-gal. pylon droppable fuel tank.
90.* 140-gal. wing-tip droppable fuel tank.
91.* Fuel lines to wing-tip and pylon tanks.
92.* Pylon tank air vent.
93.* Fuel-tank filler caps.

Hydraulic System
94. Main hydraulic panel.
95. Hydraulic accumulators.
96. Pressure gauges.
97. Selector valve.
98. Pressure transmitters.
99. Fluid pressure filters.

Armament
100. Sidewinder 1-A air-to-air heat-seeking missile.
101. Missile launching rail.
102. Infra-red heat-seeking head.
103. Servo system.
104. Control fins.
105. Warhead.
106. Proximity fuse.
107. Solid-propellent rocket motor.
108. Propulsion tube.
109. Stabilizing fins.
110. Six-barrelled 20-mm. M61 Vulcan air-cooled cannon.
111. M61 gun mount.
112.* Ammunition case.
113. Empty cartridge ejector chute.

Equipment
114. NASARR radar antenna.
115. NASARR Type R22-A search and ranging radar unit.
116. Air pressure regulator.
117. Director-type gunsight and camera installation.
118. Main instrument panel.
119. Instrument panel anti-glare shield.
120. Lower instrument centre console, including radar scope and fire-control panel.
121.* Rear-view mirrors.
122. Cockpit air duct.
123. Inertial navigator platform.
124. In-range computer.
125. Taxi light, 150w. 28v. DC.
126. Emergency power ram-air turbine unit.
127. Main landing lights, 450w. 28v. DC.
128. Primary heat exchanger.
129.* Liquid oxygen converter and equipment.
130.* High-voltage junction boxes.
131.* Circuit breakers and junction box.
132.* Two three-phase 20-kVA. engine-driven generators supplying variable-frequency AC primary power.
133.* Angle-of-attack transducer.
134.* "Jeep-can" electronic air-cooled packages, included in the electronic equipment are: NASARR radar; bomb computer; air data computer; dead-reckoning navigator; TACAN; and data-linktime division unit.

* **On small illustration.**

tor access panel.
keelson assembly supporting main gear leg struts and actuators, etc.
ne external stores shackle with capacity.
louvres for M61 gun cooling air.
be for M61 gun.
compartment servicing panel.
let for cooling air to NASARR equip-

adome support sliding rails, providing cess to NASARR equipment.

d retracting steerable nosewheel.
nding-gear shock absorber.
nding-gear doors.
perating mechanism.
barrier tape deflectors.
nding wheels with anti-skid brakes.
heel axle assembly.
anding-gear leg strut; liquid spring s, 40 actuators, 41.
ing linkage for turning wheels into position.
landing-gear doors; forward doors g to almost closed position when down, 44.

European Aircraft Industry . . . .

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As a piece of military equipment the principal interest

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in the Super Starfighter lies in its engineering as a weapons system. It is, in fact, equipped with a complex electronic fire-control system for air-to-ground and air-to-air precision attack.

So far as its actual armament is concerned it can carry a variety of loads dependent on the rôle for which it is required. For example, for ground attack it mounts a Vulcan six-barrel 20-mm. cannon; this is located below and behind the cockpit towards the port side of the fuselage. Electrically driven, the six barrels of the cannon rotate and fire one round at a time in turn and independently of each other. The gun is air cooled; during firing, the shells are retained and links are ejected downward.

For ground attack, too, GAM83 Bullpup air-to-ground missiles can be carried on under-wing pylons. Bombs can be hung from wing-pylon racks capable of mounting 1,000-lb. general-purpose bombs, or on a rack beneath the fuselage that can accommodate all sizes of bomb up to 2,000-lb. units. All bombs on the F104G are armed electrically.

As its principal air-to-air anti-aircraft armament the F104 can carry a pair of Sidewinder infra-red homing missiles—one on each wing tip. These missiles are, incidentally, also to be manufactured in Europe. Other air-to-air weapons that can be carried on under-wing pylons are 2.75-in. folding-fin rocket projectiles.

Fire-control Equipment

A North American Search and Range Radar (NASARR) forms the central part of the Super Starfighters' complete fire-control system. This equipment provides range information for visual bombing; ground mapping for all-weather bombing and navigation; contour mapping for navigation; and terrain avoidance for low-level operations. With a fire-control computer, the NASARR system gives radar search, acquisition and automatic tracking for lead-collision attack with missiles, lead-pursuit attack with the Vulcan cannon, or pursuit attack with missiles.

A director-type gunsight is used for the cannon and gives optical indication of line of sight with the lead angle computed by the NASARR computer.

In addition to this fire-control computer there is a bombing computer which gives a choice of four types of bomb delivery including dive-toss and over-the-shoulder bombing. The appropriate information is supplied to this and to other units by an air data computer located in the aircraft's electronics bay. This computer can supply information to as many as six other systems if required.

Accurate navigation is as much a part of fire control as accurate aiming and for this the F104G is equipped with TACAN. This provides the pilot with instantaneous and continuous data regarding his distance from and direction to a given ground station.

A self-contained lightweight and fully automatic inertial guidance system is also provided. In addition to giving navigational information this equipment also supplies the other electronic systems with the data they require in respect of heading, pitch and roll.

For normal command communications, the European Super Starfighters will have UHF equipment.

Electrical power for all these, and other, equipment in the aircraft is supplied by four generators. For the general electrical services there are two 20-kVA generators driven from the main powerplant. A 2.5-kVA 400-cycle fixed-frequency generator driven by an hydraulic motor supplies the electronics systems and the engine instruments. For emergency use there is a 4.5-kVA. generator driven by a ram-air turbine unit.

The system as a whole has been designed so that if one of the two main generators should fail, part of the "non-essential" load (such as two fuel booster pumps, auxiliary fuel transfer pump, duct anti-icing, and one of the cannon motors) is cut out and the remaining load is transferred to the other main generator. Should the electronics system generator fail, its load is automatically transferred to the two main generators. The emergency system can cater for all essential electrical functions including radio.

Hydraulic power for control surface operation, undercarriage retraction and nose-wheel steering, is provided by two independent 3,000-p.s.i. systems. These are normally both operating, but each of them is capable of supplying sufficient hydraulic pressure and flow to operate the flying controls at a reduced rate in the event of a failure of one system. The engine-driven pumps used in these systems are of the variable-displacement type.

In the event of a complete powerplant failure and, therefore, a loss of both the primary hydraulic systems, an emergency ram-air turbine-driven pump is brought into operation. This will give enough pressure and flow to enable control to be maintained and landing manœuvres to be accomplished.

A particularly interesting feature of the Super Starfighter's control arrangements is the incorporation of boundary-layer control in the form of flap blowing to bring the stalling speed and landing performance down to an acceptable level. This particular type of high-lift device has been incorporated because the extreme thinness of the Starfighter wing made it very difficult to embody the flap tracks and rollers required for the normal Fowler-type flaps.

For this system air is tapped from the powerplant compressor and ducted into the wing where it is led to a slotted tube at the leading-edge of the flaps. Control of the efflux over the flap surface is achieved automatically and is linked to the flap movement. At a deflection of 15° the controlling valve begins to open; the full jet does not come into operation until the flap has reached its 45° position.

As already mentioned, the principal airframe difference between the European Super Starfighter and earlier versions is the incorporation of a larger vertical tail surface. A feature of this new tail is that the rudder is powered by an irreversible hydraulic unit.

As one would expect of a Mach 2 fighter, the structure of the Starfighter is more than usually "solid" and throughout the airframe integrally machined and chemically milled components are the rule rather than the exception. In this particular direction, the Super Starfighter airframe has been markedly "refined" compared with its predecessors, for certain areas of the structure have had to be re-engineered to cater for the heavier stresses arising from high-speed low-altitude operations. Some 36 new forgings, for example, are said to have been provided for such major components as fuselage main frames, wing fittings and spars, fuselage longerons and joints, fuselage tail frames, tail unit spars and ribs, as well as for some fuselage skin panels.

The F104 wing is built as port and starboard units which are attached at the fuselage sides to five main hoop frames. Each wing is a two-spar unit with single machined top and bottom skins. At the root these skins are 0.25 in. thick; they taper to 0.125 in. at the tip and are formed to the aerofoil contour. There are no chordwise ribs in this torsion box but there are 12 spanwise intermediate channel members.

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The major portion of the centre fuselage is taken up by the engine air intake ducts and five bag-type fuel tanks. The rear fuselage carries the powerplant and tail unit and is largely constructed in stainless steel and titanium.

European Commitment

In the initial phases of this European production of an American aeroplane, a large number of components built in the United States have been sent across the Atlantic for assembly in Germany and elsewhere. As the programme develops, however, and as the local Continental production lines get into their stride, so the proportion of "home produced" components will be reduced until eventually nearly the whole airframe will be of European manufacture; one report has suggested a figure of 95% by 1963.

In any event, this exercise has come to be one of the major production enterprises on the other side of the Channel. The building of 949 Mach 2 fighters is no small undertaking. And quite apart from the political and strategic implications of such an enterprise, it will provide a large number of people with some invaluable experience in aeronautical production engineering.

in the Super Starfighter lies in its engineering as a weapons system. It is, in fact, equipped with a complex electronic fire-control system for air-to-ground and air-to-air precision attack.

So far as its actual armament is concerned it can carry a variety of loads dependent on the rôle for which it is required. For example, for ground attack it mounts a Vulcan six-barrel 20-mm. cannon; this is located below and behind the cockpit towards the port side of the fuselage. Electrically driven, the six barrels of the cannon rotate and fire one round at a time in turn and independently of each other. The gun is air cooled; during firing, the shells are retained and links are ejected downward.

For ground attack, too, GAM83 Bullpup air-to-ground missiles can be carried on under-wing pylons. Bombs can be hung from wing-pylon racks capable of mounting 1,000-lb. general-purpose bombs, or on a rack beneath the fuselage that can accommodate all sizes of bomb up to 2,000-lb. units. All bombs on the F104G are armed electrically.

As its principal air-to-air anti-aircraft armament the F104 can carry a pair of Sidewinder infra-red homing missiles—one on each wing tip. These missiles are, incidentally, also to be manufactured in Europe. Other air-to-air weapons that can be carried on under-wing pylons are 2.75-in. folding-fin rocket projectiles.

Fire-control Equipment

A North American Search and Range Radar (NASARR) forms the central part of the Super Starfighters' complete fire-control system. This equipment provides range information for visual bombing; ground mapping for all-weather bombing and navigation; contour mapping for navigation; and terrain avoidance for low-level operations. With a fire-control computer, the NASARR system gives radar search, acquisition and automatic tracking for lead-collision attack with missiles, lead-pursuit attack with the Vulcan cannon, or pursuit attack with missiles.

A director-type gunsight is used for the cannon and gives optical indication of line of sight with the lead angle computed by the NASARR computer.

In addition to this fire-control computer there is a bombing computer which gives a choice of four types of bomb delivery including dive-toss and over-the-shoulder bombing. The appropriate information is supplied to this and to other units by an air data computer located in the aircraft's electronics bay. This computer can supply information to as many as six other systems if required.

Accurate navigation is as much a part of fire control as accurate aiming and for this the F104G is equipped with TACAN. This provides the pilot with instantaneous and continuous data regarding his distance from and direction to a given ground station.

A self-contained lightweight and fully automatic inertial guidance system is also provided. In addition to giving navigational information this equipment also supplies the other electronic systems with the data they require in respect of heading, pitch and roll.

For normal command communications, the European Super Starfighters will have UHF equipment.

Electrical power for all these, and other, equipment in the aircraft is supplied by four generators. For the general electrical services there are two 20-kVA generators driven from the main powerplant. A 2.5-kVA 400-cycle fixed-frequency generator driven by an hydraulic motor supplies the electronics systems and the engine instruments. For emergency use there is a 4.5-kVA. generator driven by a ram-air turbine unit.

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European Aircraft Industry . . . .

Franco-German Transport Alliance

A MILITARY transport with a cargo hold identical in size to a Continental railway wagon is being developed jointly by France and Germany. This aircraft, the Transall C-160, is to be powered by Rolls-Royce Tyne engines and will make its first flight in the autumn of next year. It can be used as a freighter, as a transport carrying 80 armed soldiers or 66 wounded on stretchers, or for the dropping of paratroops and supplies. Although twin-engined, the Transall is a large aircraft with a wingspan of more than 130 ft. and an all-up weight above 100,000 lb.

It was conceived as a replacement for the Nord Noratlas which is in service with both the French and West German air forces. The French requirement was for a strategic transport for liaison with overseas territories of the French Community, while the Germans needed a STOL freighter and assault transport. Although these requirements appeared incompatible, the two Governments decided to collaborate on the development of a single aircraft to meet them.

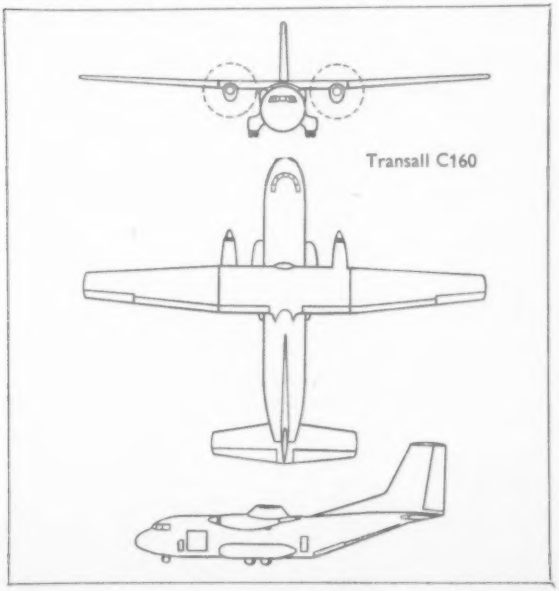
Studies were made during 1957; and in June, 1958, a commission of French, German and Italian representatives decided on a specification suitable for the air forces of all three countries.

The commission met again in December, 1958, and eliminated all but five of the projects submitted. After further study the field was narrowed to two proposals, those of Nord Aviation and Weser Flugzeugbau. As a result it was decided to develop a joint aircraft based on these proposals; Nord was to be the French company involved, and Weser Flugzeugbau, Hamburger Flugzeugbau and Blume the German ones. An agreement for joint development was signed in Bonn on Jan. 28, 1959. The group so formed was named the Transport Alliance, abbreviated to Transall.

A design team of French and German engineers was set up at the Bremen offices of Weser in May to decide the final outlines of the project. It was named the Transall C-160; C for cargo and 160 denoting the wing area in sq. metres. At one stage the idea of naming it the C-40 had been considered, where 40 was the all-up weight in tonnes, but this was rejected because the weight was likely to change during development.

In December, 1959, the French and German Governments signed an agreement which laid down the principles for C-160 development, which will be paid for by the two governments on a 50/50 basis. Italy is represented on the Transall committee but is not financially involved in the project.

Weser was appointed overall manager of the project and to be responsible for design and production of the main body of the fuselage and tail unit in conjunction with Blume, which is working only on design. Nord Aviation was to be responsible for designing and constructing the wing and nacelles, and Hamburger Flugzeugbau the front fuselage.



Other major suppliers are: Tyne powerplants, Rolls-Royce; propellers, de Havilland; fuselage-mounted undercarriage and tyres, Messier. Normalair is supplying the pressurization and air-conditioning system. For the prototypes, Rolls-Royce will supply Tynes direct from Britain, but Tynes for production aircraft will probably be built under licence in France by Hispano-Suiza. No production aircraft have yet been ordered.

At present five prototypes are being built, two for ground testing and three for flight trials. Construction began last October and the bare fuselage for the first aircraft will be received from Germany in July, 1962, for assembly at Melun-Villaroche, near Paris. Flight trials will probably be made in France by a combined Franco-German team. The other two prototypes will be assembled and test-flown in Germany.

To improve its take-off run, the C-160 will have larger-diameter propellers than the Breguet Atlantic. For STOL operation (30 m. take-off) the Germans want it to be equipped with underwing pods carrying Rolls-Royce Spey by-pass engines. The use of blown flaps to reduce take-off and landing runs has been studied, but underwing pods are the more likely.

As already mentioned, the freight volume inside the C-160 is the exact size and cross-section of a Continental railway wagon—3.15 m. wide, 2.93 m. high and 13 m. long (10 ft. 4 in. by 9 ft. 10 in. by 42 ft. 8 in.) so that it can accommodate any normal load that is conveyable by rail. It will carry its normal payload of 8 tonnes (17,650 lb.) for 4,500 km. (2,796 miles), and 15 tonnes over a distance of 2,200 km. (1,367 miles).

The aircraft is of high-wing layout and has a rear loading door which can be lowered to form a ramp. The structure is designed on fail-safe principles.

The Messier undercarriage has low-pressure tyres and a twin-wheel nose unit. Each main undercarriage unit has four wheels and is mounted on the fuselage side; the wheels can be raised to lower the fuselage for loading. Despite the narrow-track undercarriage, it is claimed the aircraft can take-off and land in side winds greater than 25 m.p.h.

The C-160 is air-conditioned and pressurized by a system for which Normalair has been given complete development responsibility. Differential pressure is 4.59 p.s.i., equivalent to a cabin altitude of 11,480 ft. when the aircraft is cruising at 26,250 ft. A feature of the system is a complete refrigeration package, with heat exchangers, bootstrap cold-air unit and temperature controls, which is mounted ahead of the wheels in one undercarriage fairing. An Airesearch APU is mounted in the other undercarriage fairing: this supplies compressed air for engine starting and hydraulic power for loading. In conjunction with the refrigeration unit it allows the aircraft interior to be kept cool on the ground without the Tynes running.

DIMENSIONS.—Span, 40 m. (131 ft. 3 in.); overall length, 31.1 m. (102 ft.); height, 11.7 m. (38 ft. 5 in.); wing area, 160 m.² (1,722 sq. ft.).

WEIGHTS.—Max. take-off, 48,500 kg. (106,925 lb.); max. landing, 45,800 kg. (100,970 lb.); max. zero-fuel, 40,840 kg. (90,057 lb.); max. payload, 15,000 kg. (33,070 lb.).

POWERPLANT.—Two Rolls-Royce Tyne RTy. 20 turboprops of more than 6,000 e.h.p. each.

PERFORMANCE.—Take-off ground run (STOL technique), 570 m. (1,870 ft.); sea-level rate of climb on two engines, 9 m./sec. (1,770 ft./min.); cruising speed at 7,500 m. (24,600 ft.), 510 km./h. (317 m.p.h.) with fuel flow of 1,085 kg./h. (2,392 lb./h.). Max. range, 4,500 km. (2,796 miles). Landing ground-run (STOL technique), 315 m. (1,019 ft.).

The Fighting Services . . . .

V-Bomber Readiness and Defence

HELD concurrently between May 10 and 16, this year's two major R.A.F. exercises were designed to test as many aspects as possible of the offensive and defensive elements of our deterrent forces.

In the first exercise, code-named "Mayflight," Bomber Command's ability to alert, disperse and subsequently scramble its V-bomber force was practised. The second exercise, known as "Matador," tested the rôle of Fighter Command to detect and combat enemy activity, and alert the strike element of our deterrent in the United Kingdom.

Under the respective direction of the A.O.C.-in-C., Bomber Command, Air Marshal Sir Kenneth Cross, and the A.O.C.-in-C., Fighter Command, Air Marshal Sir Hector McGregor, the two exercises also included the Royal Observer Corps and the testing of the nuclear incident and fall-out reporting organization. "Enemy" forces which made simulated attacks against this country came from the R.A.F. in Germany, the U.S.A.F.E., and the 1st Air Division of the R.C.A.F., as well as from Bomber Command.

Generally polishing-up and testing new and modified operating techniques, "Mayflight" opened with simulated attacks by Canberras from Germany and Norway. The "enemy" aircraft broke the Fighter Command radar warning chain and initiated the scrambling of the pre-dispersed V-bomber force. Airborne crews then flew to the position line east of the United Kingdom over which they must not proceed until the final "go-ahead" has been received. Under normal conditions V-bomber crews would automatically return direct to their bases if this command is not issued, but for exercise purposes they returned via the North Sea to test the defending fighter forces.

The complete Bomber Command warning and scramble system was tested several times during the exercise period. Returning V-bombers also simulated raids against the United Kingdom to provide targets for Fighter Command Lightnings, Javelins, Hunters and Bloodhound ground-to-air missile squadrons taking part in "Matador."

Background to the Exercise

At the present time the rôle of Bomber Command can be divided into three parts—to act as the principal British deterrent; to provide reinforcements for overseas theatres such as N.E.A.F., M.E.A.F. and F.E.A.F.; and to destroy the enemy's will to fight in the event of a full global War.

For these tasks the Command now has four forces divided between its two Groups. These comprise the medium V-bomber force; the Victor, Valiant and Canberra reconnaissance units; Valiants and Canberras under the operational command of SACEUR; and the 20 Thor missile squadrons under joint British-American control.

The V-bombers can be divided into three categories. There are the Valiants which are in the process of being replaced by the Mark 2 V-bombers and permanently converted to the tanker rôle; Victor B.1s and Vulcan B.1s which are capable of operating at Mach 0.9 over the target; the third category comprises Vulcan B.2s and, later this year, Victor B.2s. Weapons in service cover mines, high explosive and free-falling nuclear bombs, which will be supplemented by the Blue Steel stand-off bomb next year and Skybolt in 1964.

V-BOMBER DISPERSAL.—Part of the alert concept is the dispersal of the V-bomber force. Here, Victor B.1s of No. 15 Squadron are seen at a West Country airfield.

Photographs copyright "The Aeroplane and Astronautics"

LATEST MARK.—Avro Vulcan B.2s of Nos. 27 and 83 Squadrons lined up at R.A.F. Scampton during "Mayflight," the Bomber Command alert and readiness exercise.

One of the most important aspects of "Mayflight" was the testing of the Bomber Command alert concept. Under this scheme there are three main safety requirements designed to enable the V-bombers to survive an enemy attack. The first is early warning—either strategic, through political sources, or tactical by means of the Fighter Command, NATO and NORAD early warning radar chains. The second is a well-tried bomber readiness plan. This is followed by the third stage—dispersal—in which the V-bombers are moved from their main bases to various airfields within the United Kingdom.

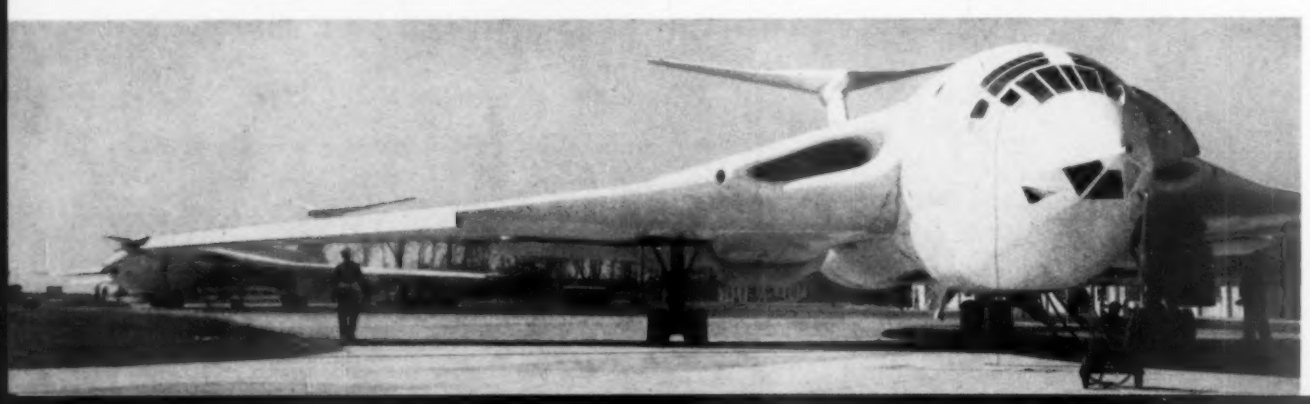
By no means are all these airfields in Bomber Command; a maximum of four aircraft are dispersed at any one station. From a main Bomber Command base operating three squadrons of eight aircraft each, five such dispersal airfields would be used.

Another factor affecting the possible minimum warning time that the V-bomber force can expect to receive is the form and development of the threat. For subsonic bombers the warning time is estimated to be 40 min., while an attack by supersonic aircraft would reduce this period to 15 min. For IRBMs launched from bases at a range of 1,000 miles the warning time is again reduced to 8 min., and the siting of such weapons only 650 miles from the U.K. provides a warning time of 4 min.

To counter this steadily reducing warning time four states of readiness are employed. First there is Blue, with an alert period of 30 min. This is followed by Red, with a standby time of 10 min.; Black, for 5 min.; and Amber, the top, or minimum time, giving a 3-min. alert. For Red the crews are by their aircraft, and for Black and Amber they are in the cockpit. As yet, there is no flying alert in the Command.

Two factors which have helped considerably to reduce the alert times of status Black and Amber are the direct linking of every V-bomber cockpit by a telescramble land-line network to Bomber Command operations centre, and the ability to start all four V-bomber engines together. Four aircraft O.R.P.s (operational readiness platforms) are also being constructed at dispersal airfields.

In addition to these O.R.P.s under construction, all dispersal airfields have readiness platforms comprising a hardstanding for the four V-bomber detachment, operations rooms and living quarters for the air- and ground-crews.—P.R.R.



A Liquid Hydrogen Stage for Blue Streak

ONE way of increasing the performance of existing rocket vehicles is to employ high-energy propellents in the top stages. A comprehensive paper outlining the prospects for "up-rating" the performance of the final stage of the proposed three-stage satellite launcher, based on Blue Streak and Black Knight, was presented at the recent B.I.S. Symposium on "Liquid Hydrogen as a Rocket Propellent."

The original R.A.E./R.P.E. concept for the British launching vehicle, it will be recalled, proposed a "vernier" final stage which employed H.T.P./kerosene as propellents (Ref. 1). The present paper, "The Use of Liquid Hydrogen in the Third Stage of a Satellite Vehicle," has been produced by Messrs. A. B. Bailey, R. G. Cruddace and B. W. A. Ricketson of R.P.E., Westcott, with the view to examining the potential of an LO_2/LH_2 top stage for a range of missions from a close circular orbit to a soft-landing on the Moon. They also give detailed consideration to the design of an oxygen-hydrogen engine with a thrust of 2,020 lb.

Propellent Properties

The low density and low boiling point of liquid hydrogen are frequently quoted against its use in rocket vehicles. A low density implies large propellent tanks with consequent reduction in payload. However, the oxidant to fuel mass-ratio lies between four and five for the maximum performance of oxygen-hydrogen engines in a satellite vehicle. This must be compared with a typical oxygen-kerosene engine which uses a mixture ratio of 2.3 : 1. Thus the equivalent mass of hydrogen is only about half that of kerosene in the equivalent system.

The difference in temperature between the boiling point of hydrogen and room temperature is only 35% greater than the difference between the boiling point of oxygen and room temperature. If allowance is made for this, the increase in tank size, and the enthalpy of vaporization, one needs about 2.5 times more insulation mass for a hydrogen tank than for an oxygen tank holding the same mass if the same evaporation loss is to be tolerated in each case. The conclusion is that the low boiling point and density of liquid hydrogen can be accommodated by present-day engineering practice, but that research and development in tank materials and low-density insulation must continue if minimal structural masses are to be realized.

Fig. 1 shows a hypothetical oxygen-hydrogen top stage (for the Blue Streak/Black Knight concept) which has been designed to facilitate an estimation of the mass of the total vehicle structure. The cylindrical propellent tanks are pressurized to feed the engine, the pressure being more than sufficient to support the payload acceleration forces. Integral tank construction is used, the oxygen tank being separated from the hydrogen tank by a metal diaphragm of the same shape as the end domes. The diaphragm supports a small pressure differential and has a minimum thickness set by fabrication considerations of .02 in.

The first and second stage thrust loads are transmitted to the tank via a short length of vehicle skirt and a load-diffusing structure situated at the periphery of the hydrogen tank dome, as indicated in the diagram. A similar structure at the periphery of the hydrogen dome transmits thrust loads to a payload support ring. Separation of the second and third stages is achieved by eight explosive bolts located at the base of the short skirt. Chamber thrust loads are transmitted to a single frame of cast magnesium alloy and through 12 thrust rods to the diffusing structure. Extensive use of magnesium and aluminium alloys was assumed in obtaining the weight analysis (Table 1).

Four thrust chambers are employed in the propulsion unit, each swivelling on an axis normal to the vehicle axis to provide control in roll, pitch and yaw. The trunnions are located at the chamber throat and swivel in the thrust frame. The nominal thrust has been fixed at 2,020 lb.

Insulation Problems

One of the problems which arise in the use of liquid oxygen/liquid hydrogen systems is that of minimizing propellent evaporation during the pre-launch period. The propellent tanks must also be protected from the effects of kinetic heating during the ascent, and from solar radiation upon emerging from the atmosphere. Three tank insulates were considered: foamed plastics, evacuated powders, and evacuated foil-laminates. For example, the Guided Weapons Department of R.A.E. has investigated the kinetic heating of the third stage liquid hydrogen tank, insulated internally with a 2.5 cm. thick layer of foamed plastic, the tank wall acting as the "heat sink." A typical calculation shows that the wall temperature reaches 430° K. and since the maximum working temperature of the insulant is only 350°, melting of the adjacent foam layer would occur. A thermal insulant such as cork would be needed therefore to separate the foam from the metal wall.

TABLE 1. BREAKDOWN OF DRY STRUCTURE MASS

Tank diameter	Engine mass	Thrust structure mass	10% growth	Total mass
ft.	lb.	lb.	lb.	lb.
Turbo-pump 4.6	108.2	76.5	18.5	203.3
Feed system 7.2		97.0	20.5	225.8
9.8		117.7	22.7	248.7
Pressure 4.6	95.0	76.5	16.9	188.5
Feed system 7.2		97.0	19.2	211.2
9.8		117.7	21.1	233.9

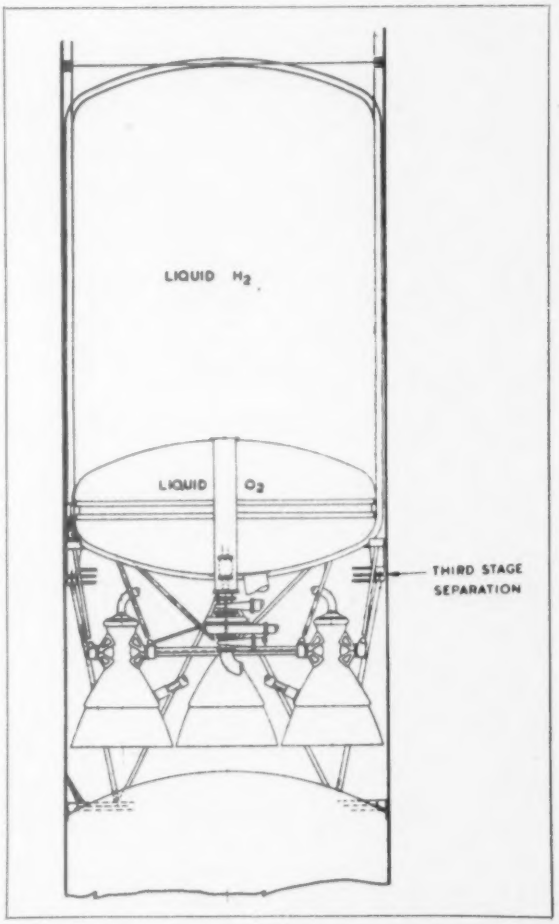


Fig. 1. Layout of the proposed LO_2/LH_2 third stage for Blue Streak and Black Knight. Mass 5,005 lb.; thrust 2,020 lb.; o/f mixture ratio 4.8/1; mission, circular orbit at 298 miles; and payload, 2,866 lb. Stage diameter, 4 ft. 6 in.

Payload Growth

The authors of the paper conclude that the use of liquid hydrogen/liquid oxygen in the third stage of the proposed Blue Streak/Black Knight launcher, in place of H.T.P./kerosene, would realize payload increases of 50% for a close Earth-satellite and 400% for an escape mission (Table 2). Of particular interest is the mission to establish a communication satellite in a circular orbit at a height of 8,000 km., which may reflect a G.P.O. requirement.

It is pointed out that a small project of the type described,

centred around a low-thrust third stage propulsion system, offers the U.K. an opportunity to enter a new field with fresh ideas and to promote important advances in rocket propulsion. These advances could include integral propellent tank construction using titanium alloys, tank self-pressurization systems, "topping" turbo-pumps, high performance insulation propellent tanks, reliable multi-start ignition systems for vacuum operation, radiation-cooled nozzles, and reliable low-temperature propellent control valves. The pressurized-tank feed system, perhaps in conjunction with the jet pump, is competitive with the turbo-pump feed system and is considered to have great promise for the attainment of high reliability in the initial stages of a space programme. The various systems are outlined in Table 3.

One important factor, the authors conclude, is that one is designing systems for operation in a vacuum. Facilities for investigating the starting, running and control of space propulsion systems at very low pressures are essential if accurate performance data and high reliability are to be obtained before the initiation of flight tests.

TABLE 2. MISSION SPECIFICATIONS

Mission	Perigee height	Apogee height	Third stage initial acceleration	Third stage thrust	Third stage characteristic velocity	Third stage mass
Close circular orbit ..	miles 298	miles 298	ft./sec² 6.56	lb. 1,010	miles/sec. 1.18	lb. 5,005
Elliptic orbit	298	9,936	13.12	2,020	2.31	5,005
Space probe orbit ..	298	99,360	13.12	2,020	3.01	5,005
Communication satellite (Polar orbit) ..	4,968	4,968	13.12	2,020	2.60	5,005
Communication satellite (Equatorial orbit) ..	4,968	4,968	Initial thrust phase 9.2 / 11.8; Final thrust phase ~0.33	Initial thrust phase 2,020 / 3,030; Final thrust phase ~0.45	3.63	8,004

TABLE 3. FUEL SYSTEM CRITERIA

System	Advantages	Disadvantages
1. PRESSURIZED	Simplicity, reliability.	Probable tank mass penalty, lower chamber performance.
2. JET PUMPS	Low mass, no moving parts thus good reliability, no propellent loss involved in pumping.	Intermediate system pressures only, possible control problems. Undeveloped system.
3. TURBO-PUMPS	High system pressures possible.	Greater complexity, reduced reliability, longer development time.
(a) Gas generator system	Large quantities of energy readily available.	Loss of performance due to inefficient propellent utilization, complex control system.
(b) Bleed system	Simplified system.	Loss of performance due to inefficient propellent utilization.
(c) Topping system	Turbine exhaust used in combustion chamber. No turbine temperature problems.	High turbine mass. Chamber pressure level limitations set by energy available.

REFERENCE

(1) Cornford, E. C., "A British Space Booster," THE AEROPLANE AND ASTRONAUTICS, Aug. 12, 1960, pp. 186-188.

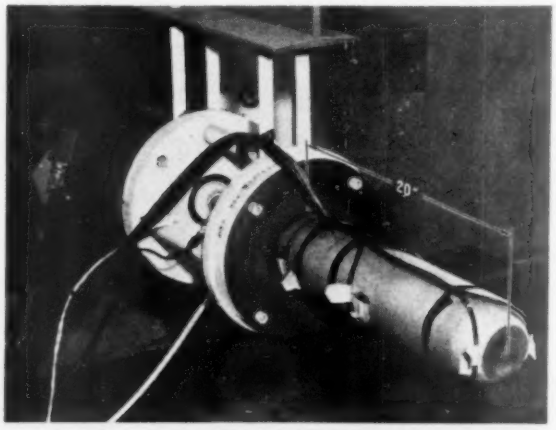
Lighting the "Blue Touch-paper"

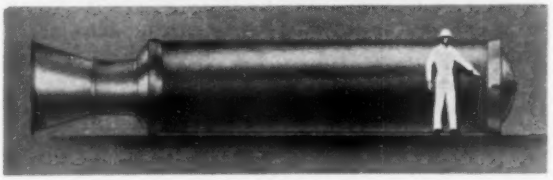
AEROJET-GENERAL CORP. describe the igniter which they have recently developed for starting their big solid-propellent rocket engines as "The World's largest match." The powerful pyrotechnic device, which itself produces a thrust greater than most present day single-stage solid rockets, was used to ignite the first sub-scale motor in Aerojet's Large Segmented Solid Rocket Engine Program which the company is conducting under a U.S.A.F. contract.

Fitted inside the head of the rocket engine, the igniter has a length of 20 in. and a diameter of 5 in. When fired, it shoots a "controlled flame" down the centre of the long motor to ignite the propellent grain which has a hollow centre.

A recent demonstration using a "test fixture filled with propellent" has shown the practicability of igniting the entire burning surface without undue pressure or shock.

The present igniter is yet but a step towards the huge igniters which will be required in the new generation of large solid rockets. Already in the design stage at Aerojet is one such device intended for the ignition of full-scale segmented rockets which "will deliver a thrust equal to that of seven modern jet-fighters."





The 20 in. Aerojet igniter which fits into the forward end of the rocket engine and shoots a controlled flame down the length of the hollow propellent grain. Lower picture, the igniter in position.

Mock-up of the 250,000 lb. thrust segmented rocket engine under construction by the United Technology Corporation. The unit stands 26 ft. 6 in. tall and is 10 ft. in diameter at its widest section.

Of the engines themselves, Aerojet has reported to NASA that a solid unit developing a thrust of 2,000,000 lb. could be produced within two years. A multi-stage rocket based on this first-stage engine could place a payload of 44,000 lb. in close-orbit around the Earth. The production cost would be "less than half the price of comparable liquid propellent rocket engines."

Within three years, Aerojet consider that solid rockets, built on the segmented principle, could be orbiting payloads of 170,000 lb., if the programme were pursued with vigour.

Further evidence of NASA's increasing interest in big

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Discussing Satellite Communications

PLANS for the exploitation of space by the telecommunication engineers are now well advanced, with various projects for satellites intended to serve as relay stations for telephone, telegraph and television services. This promising new field of research and development was the theme of a well-attended Symposium on Communication Satellites organized by the British Interplanetary Society at the headquarters of the Federation of British Industries in London on May 12.

The meeting served to bring together leading British and American authorities and undoubtedly resulted in a useful exchange of views and technical information. Several speakers stressed the importance of obtaining the maximum amount of co-operation, including the need to achieve international agreement in the allocation of radio frequencies and the maintenance of compatible operating standards throughout any World systems that may be developed.

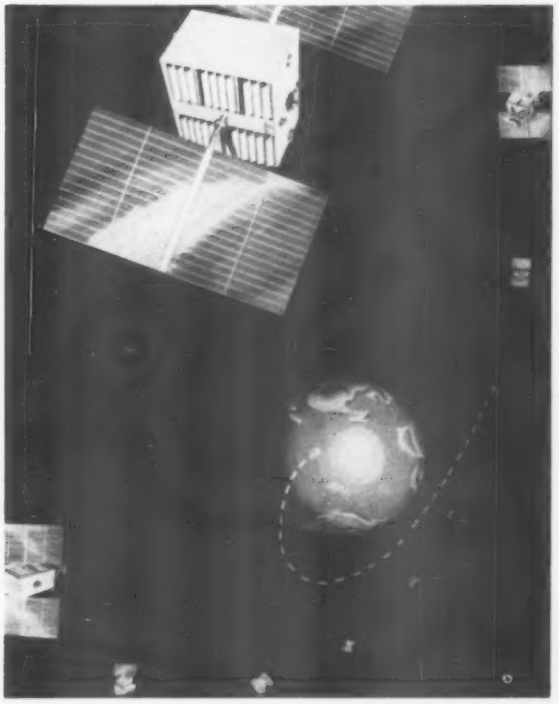
Dr. J. R. Pierce (Bell Telephone Laboratories) pointed out that in each country the agency which provides the telephone service owns and operates transatlantic radio terminals and international telephone cables are owned jointly by the agencies of the country they interconnect. Thus, the cable connecting the United States and Great Britain is owned jointly and equally by the British G.P.O. and the American Telephone and Telegraph Company. Dr. Pierce said it seemed to him that the quickest, surest, and perhaps the only way of achieving useful, mutually profitable satellite communications "is within this established, functioning, non-political international framework of co-operative technical standards, ownership and operation."

Cost Analysis

Of the economic value of developing telephone repeater satellites, there was little doubt. The economic surveys carried out in this country under Dr. W. F. Hilton (Hawker Siddeley Aviation) and G. K. C. Pardoe (de Havilland Aircraft) have indicated that satellites can be worthy competitors to the submarine cable, and this view was reinforced at the meeting. In Dr. Hilton's opinion, 6d. a minute calls between London and Brisbane would not be impossible in full development.

Concerning the satellites and their orbits, opinions varied widely among the various speakers although there was perhaps less enthusiasm expressed for the 24-hr. synchronous satellite (which remains "fixed" above the equator at a height of some 22,300 miles) for telephone services.

Dr. Hilton presented the case for a system of satellites pursuing elliptical orbits inclined at 63° to the equator with a 12,600-mile apogee. He thought the economics appeared to favour eight heavy satellites having attitude stabilization and station-keeping properties. Suppose, he said, that the satellite life is only a year and we allow 16 rockets for orbiting eight satellites per annum (assuming 50% successful), using Blue Streak and two tailored upper stages at £1m. each; this would cost £16m. p.a.



Ground stations have been estimated to cost about £1m. each and may be written off over a period of about 10 years. The cost of a 24-ground-station system is then £2.4m. p.a. Maintenance, administration and running costs of this number of ground terminals, and the computing centre (for aiming the tracking aerials) will probably be in the region of £10m. p.a.

The total cost of the system, if the above are reasonable, will be rather less than an annual sum of £30m.

Eight satellites, Dr. Hilton continued, each with 720 channels, would offer a potential 3,109m. channel minutes per annum. If the present intercontinental telephone rate of £1 per minute is charged, 1% utilization must be achieved to break even. This 30m. minutes is to be compared with the present level of some 225m. paid minutes per annum for total World long-distance telecommunications. It is, of course, realized that only part of the existing traffic can be diverted to this new traffic route. Higher utilization would naturally result in very large profit to the operating authority.

Dr. Hilton said that the development cost of the rocket, not included above, had been estimated at about £80m. This could be paid for within a single year if utilization could be increased to about 3.7% of the system potential. In fact, a more probable course of action would be to reduce the charges considerably, spreading the development cost over a number of years but stimulating a considerable increase in the total World traffic. Ultimately, with increased demand, a rate of 6d. a minute might cover the cost of rocket launchings and the operation of the system. How can anyone afford not to do this?

The synchronous 24-hr. satellite system was compared with a ring system of 10 station-keeping satellites pursuing a circular orbit at 6,000 miles by Mr. R. P. Haviland (General Electric Co.). The latter is the subject of detailed proposals which G.E.C. have recently placed before the Federal Communications Commission in Washington.

Weighing about 1,000 lb., each satellite would incorporate four transceiver units providing an operating lifetime of at least five years. An active orbit control system in the satellites, with a minimum functional life of two months, would provide for positioning them on station within a month. The intention is that the 10 satellites should be equally spaced in a nominally circular orbit. It is considered that drift should not exceed one degree per year.

The satellites have been designed to accommodate 600 two-way telephone channels, and using power supplied by orientable solar cell panels (with internal chemical batteries), the output of the satellite transmitters would not exceed 10W. The scheme envisages the use of 18 ground terminals.

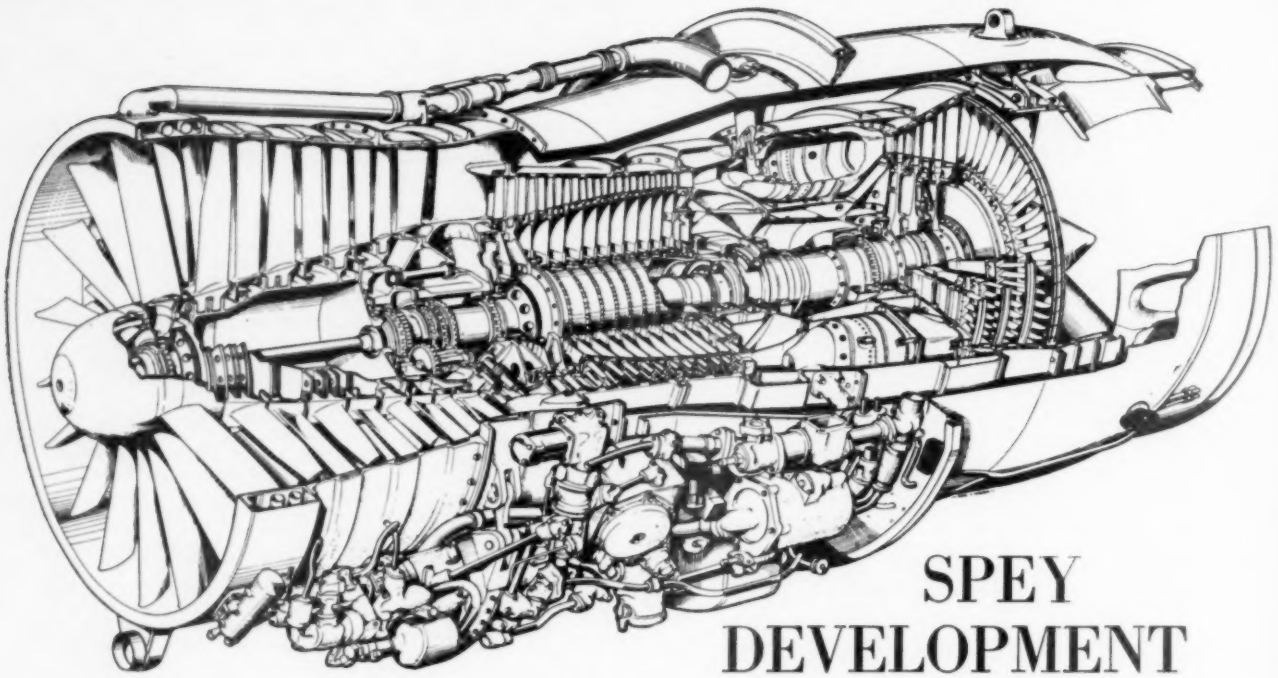
Mr. Haviland stressed that the low-orbit satellite, as proposed here, improves the situation regarding time delay and echo due to the shorter path length of signals, as compared to the 24-hr. synchronous satellite at 22,300 miles. (See THE AEROPLANE AND ASTRONAUTICS, Mar. 23, 1961, p. 322).

At the meeting, English Electric carried out an interesting demonstration which simulated the time-lapse for two speakers using a 24-hr. satellite system.

Another problem arising from the use of the synchronous equatorial satellite is that, because only three are required for global operation—each serving nearly one-third of the Earth's surface—a catastrophic failure in one will result in a lengthy interruption in service over a wide area. Mr. Haviland said that at lower altitudes, failure in any part of the system would not be so severe because a replacement soon comes along to fill the gap. The gap introduced by a failure in the 10-satellite, low-orbit, ring system will reduce the area of continuous coverage or will introduce short interruptions in service, but this should be quickly remedied by a new launching.

(*Continued from page 562*)

"solids" is that the United Technology Corporation (a subsidiary of the United Aircraft Corp.) has been given a contract to design, fabricate and test a flight-weight, segmented, rocket engine of 250,000 lb. s.t. Weighing more than 75,000 lb., and operating for over 60 sec., it is hoped to test the new propulsion unit statically this summer.



SPEY DEVELOPMENT

NEWS of progress with the 9,850-lb.-thrust Spey (RB.163) by-pass turbojet has been given by Rolls-Royce following the announcement last week that this engine is to power the new B.A.C. One-Eleven short-haul transport. Fifteen One-Elevens have already been ordered and the Spey will also power the 24 de Havilland Tridents on order for B.E.A. Military applications are also to be expected.

Clearly the Spey is well set to become a widely-used engine, as have most Rolls-Royce types in the past. It has been designed for low fuel consumption, low maintenance costs and a long overhaul life.

Spey design work began in September, 1959, and the first engine ran in December, 1960. Five development engines are now running and have accumulated more than 250 hours—half of these by a single engine which has completed a 60-hour endurance test. Engine tests in the Rolls-Royce high-altitude plant are imminent; these will cover the full range of conditions to be met in Trident operation. Static tests at Hucknall will also begin this month with a Spey mounted in a production-type Trident engine pod complete with thrust reverser and noise-suppressor nozzle.

Test flying with the Spey will begin in August with two engines mounted in a Vulcan. Ground-running trials in the Trident will follow and engines will be supplied for the Trident prototype which is scheduled to make its first flight before the end of this year.

Civil and military Speys are being developed in accordance with an integrated programme providing for 14 bench-test engines; others will be used for flight development and endurance tests. The military contract covers initial development and a supply of prototype engines; a production contract is being negotiated.

The Spey is virtually a scaled-down version of the larger RB.141 by-pass engine which first ran in November, 1959. This was based on experience with the Conway, the first Rolls-Royce by-pass engine which has now built up very nearly 300,000 hours of civil and military operating experience. Test experience has been accumulated with nine RB.141s and this is applicable almost in its entirety to the smaller-scale Spey. In this way improvements have been incorporated in the Spey ahead of its own development.

Tests with the RB.141 have simulated entry-flow conditions with the centre air intake of the Trident. It was thus possible to go direct to Spey test-bed running with the complete centre air intake and entry cowl of the Trident.

New design features of the Spey include its fuel control system, its drum-type L.P. compressor spool and the mixer for mingling the by-pass and engine exhaust gas flows. The fuel control system, based on new principles, aims at producing a less dirt-conscious and leak-prone system of the speed-selection type. The mixer has individual chutes to direct the by-pass air into the turbine exhaust, thus ensuring good mixing of the streams to give a lower average exhaust velocity. This improves the engine's specific fuel consumption.

The Spey has a four-stage L.P. compressor driven by a two-stage L.P. turbine and a twelve-stage H.P. compressor driven by the two-stage H.P. turbine. Its guaranteed minimum take-off thrust is 9,850 lb. at sea level. A typical cruising fuel consumption is 0.766 lb./lb./hr. at 25,000 ft. and Mach. 0.78 in I.S.A. conditions.

Basic dry weight of this engine is 2,200 lb. Its length is 110 in. from its intake face to exhaust flange, and its maximum diameter is 37 in. By-pass ratio is 1.0, mass flow 202 lb./sec. and pressure ratio 16.75 : 1.

Chairman for Shorts

MR. C. E. WRANGHAM, C.B.E., B.A., is to be chairman of Short Brothers and Harland, Ltd. The appointment is made with the approval of Mr. Peter Thorneycroft, the Minister of Aviation, whose ministry holds a controlling interest in the company. Mr. C. F. Uwins, O.B.E., A.F.C., who has been acting as chairman since September, 1960, will remain a director of the company.

Until recently Mr. Wrangham, who is aged 53, was deputy chairman of Davy-Ashmore, Ltd. He was educated at Eton and Kings College, Cambridge, where he took first-class honours in classics (1928) and second-class honours in history (1929). In 1936 he became a director of C. Tennant, Sons and Co., Ltd. During the War he was at the Air Ministry and the Ministry of Aircraft Production, where he was principal officer for aircraft equipment, responsible for assessing the spares and equipment requirements of the R.A.F.

In 1944 he was appointed a director of Marine and General Life Assurance Society, over whose investment committee he presides. After the War he returned to C. Tennant, Sons and Co., Ltd.

In 1952 he joined the board of the Power-Gas Corporation, Ltd.; after becoming vice-chairman and a managing director, he became its chairman in 1960. After that company merged last year with Davy-United he became deputy chairman of the resultant company, Davy-Ashmore, Ltd., and at the same time he was elected a director of Simon-Carves, Ltd. He has now retired from these boards.

The New A.R.C. Chairman

PROF. G. TEMPLE, C.B.E., F.R.S., Ph.D., D.Sc., M.A., has been appointed chairman of the Aeronautical Research Council to succeed the late Prof. W. J. Duncan. A mathematician, he has been Sedleian Professor of Natural Philosophy at Oxford University since 1953.

Born in 1901, Prof. Temple was educated at Ealing County School, Birbeck College, London, and Trinity College, Cambridge. He was Professor of Mathematics at King's College, London, from 1932 to 1953. During the War, however, he was in the R.A.E. Mechanical Test department. There he was closely concerned with the mathematical problems relating to undercarriage design.

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** Ferranti are also producing a radar for the Royal Navy's Blackburn "Buccaneer" Strike Aircraft.*

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Personal Flying

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Further proof of East Anglian air enthusiasm, if any were needed, was provided last Sunday week, May 7, when the Waveney Flying Group held its second "fly-in" air rally at Seething. This is one of a number of ex-U.S.A.A.F. airfields in the district now used for flying as well as farming.

About 30 aircraft attended the rally and flying programme, which was unusually well organized for an event of this kind. Although no great display had been arranged, the informal events were enjoyed as much by the participating pilots, who have become used to the warm welcome extended by the East Anglian flying fraternity, as by many members of the local communities taking advantage of the sunny, if blustery afternoon.

The very strong south-westerly winds did not deter some of the more determined ultra-light enthusiasts. These included Flt. Lt. Giles Baker, making the 230-mile flight from Valley, Anglesey, in his Lycoming-engined Chilton monoplane; John Taylor, in his own-designed, home-built Taylor monoplane; and Peter Houston in the modified Turbulent made by himself. All three showed that these little aeroplanes are practical vehicles in skilful hands, although few envied Flt. Lt. Baker his very long and bumpy return flight as he set off in mid-afternoon in the teeth of the 25-30 knot wind. His Chilton was the ex-Sproule conversion, with bubble-type canopy and newly modified spats, in addition to replacement of the original Carden-Ford engine by the 55-b.h.p. Lycoming.

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Sporting parachuting should gain a number of new adherents from a short but spectacular film which made its debut last week from the Paramount company. "A Sport is Born" was shot at the Orange, Massachusetts, centre of Parachutes, Inc., the American organization which under Jacques Istel has revolutionized the art of "sky-diving" into a science, while maintaining to the maximum its sporting appeal.

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Stick-jumping from the company's Norseman "platform" two or three instructors literally fly alongside Lew Sanborn in free fall, passing a baton from one to the other four times in succession. By superb body control, Sanborn spins over as rapidly as a jet fighter doing a roll, checks instantly, and, by bringing his arms to the rear "delta" position, increases both his rate of descent and forward speed to bring other parachutists in startling proximity.

So steady is the photography that it is almost impossible to appreciate that the entire scene is plunging vertically downwards at about 120 m.p.h. The lovely wooded countryside around Orange is a pin-sharp background to many of the free-falling shots, and a tiny clearing among the trees is the target reached after a 7,000-ft. free fall by the instructors when they drop in to dinner at an adjacent restaurant. The film makes it clear that the appeal of "sky-diving" is in bringing the feel of bird flight closer to man than any other means can achieve. This is presumably why sporting parachuting is growing so rapidly in this country, as in the U.S., U.S.S.R. and most other countries of the World.

THREE OF A KIND.—Visitors to the recent "fly-in" of the Waveney Flying Group at Seething, Norfolk, included these three ultra-light single-seaters. Top is the J.A.P.-powered Turbulent built by Peter Houston, centre is the Lycoming-engined Chilton of Flt. Lt. Baker, and above is John Taylor's home-designed and -built monoplane, also with a J.A.P.

• • •

At Christchurch, Hants, the Christchurch Aero Club is now operating the ex-College of Air Training fleet of Airspeed Oxfords for advanced multi-engine training, and for Instrument Rating training and practice. The Oxfords are comprehensively equipped with VHF, ADF, ILS and other aids, and the proximity to Hurn ensures that IF training can be undertaken with the minimum positioning time.

The flying characteristics of the Oxford compare favourably with such aircraft as the DC-3, Viking, etc., and thus constitute a more useful progression than the smaller and more docile twins normally used for this type of training. The Oxford has full dual control, and is offered at £16 an hour. Special contract rates are available for 20 hours or more. Aircraft are available every day from 09.00 hrs. to dusk.

• • •

● With 30 members taking part, the Herts and Essex Aero Club of Stapleford, Essex, was the best-represented British Club at the recent Channel Islands Aero Club's international air rally. First place went to a German group. Roy Gambier, taking part in the three-day rally for the third time, and flying an Aircoupe, which attracted a great deal of attention, with club director Fred Warnell navigating, won an award of merit. The two exchanged places for the return journey on Sunday, May 7.

● Denham Flying Club reports that its new Piper Colts have arrived, and two first solos achieved. Increasing attention is being paid by club members to the use of radio, but their March bulletin contains a plea not to forget the joys of open cockpit flying exemplified by the Tiger Moth and Hawk Trainer.

● From the Lancashire Aero Club we hear that during the short month of February, only nine days were flyable, because of waterlogging and poor visibility. The flying total of 54 hr. 30 min. was 13% below average, bringing the grand total for the previous nine months to just over 1,000 hr. Nineteen flying members had booked a total of 210 hr. on a Tri-Pacer, which was due to arrive soon.

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Stick-jumping from the company's Norseman "platform" two or three instructors literally fly alongside Lew Sanborn in free fall, passing a baton from one to the other four times in succession. By superb body control, Sanborn spins over as rapidly as a jet fighter doing a roll, checks instantly, and, by bringing his arms to the rear "delta" position, increases both his rate of descent and forward speed to bring other parachutists in startling proximity.

So steady is the photography that it is almost impossible to appreciate that the entire scene is plunging vertically downwards at about 120 m.p.h. The lovely wooded countryside around Orange is a pin-sharp background to many of the free-falling shots, and a tiny clearing among the trees is the target reached after a 7,000-ft. free fall by the instructors when they drop in

THREE OF A KIND.—Visitors to the recent "fly-in" of the Waveney Flying Group at Seething, Norfolk, included these three ultra-light single-seaters. Top is the J.A.P.-powered Turbulent built by Peter Houston, centre is the Lycoming-engined Chilton of Flt. Lt. Baker, and above is John Taylor's home-designed and -built monoplane, also with a J.A.P.

to dinner at an adjacent restaurant. The film makes it clear that the appeal of "sky-diving" is in bringing the feel of bird flight closer to man than any other means can achieve. This is presumably why sporting parachuting is growing so rapidly in this country, as in the U.S., U.S.S.R. and most other countries of the World.

• • •

At Christchurch, Hants, the Christchurch Aero Club is now operating the ex-College of Air Training fleet of Airspeed Oxfords for advanced multi-engine training, and for Instrument Rating training and practice. The Oxfords are comprehensively equipped with VHF, ADF, ILS and other aids, and the proximity to Hurn ensures that IF training can be undertaken with the minimum positioning time.

The flying characteristics of the Oxford compare favourably with such aircraft as the DC-3, Viking, etc., and thus constitute a more useful progression than the smaller and more docile twins normally used for this type of training. The Oxford has full dual control, and is offered at £16 an hour. Special contract rates are available for 20 hours or more. Aircraft are available every day from 09.00 hrs. to dusk.

• • •

● With 30 members taking part, the Herts and Essex Aero Club of Stapleford, Essex, was the best-represented British Club at the recent Channel Islands Aero Club's international air rally. First place went to a German group. Roy Gambier, taking part in the three-day rally for the third time, and flying an Aircoupe, which attracted a great deal of attention, with club director Fred Warnell navigating, won an award of merit. The two exchanged places for the return journey on Sunday, May 7.

● Denham Flying Club reports that its new Piper Colts have arrived, and two first solos achieved. Increasing attention is being paid by club members to the use of radio, but their March bulletin contains a plea not to forget the joys of open cockpit flying exemplified by the Tiger Moth and Hawk Trainer.

● From the Lancashire Aero Club we hear that during the short month of February, only nine days were flyable, because of waterlogging and poor visibility. The flying total of 54 hr. 30 min. was 13% below average, bringing the grand total for the previous nine months to just over 1,000 hr. Nineteen flying members had booked a total of 210 hr. on a Tri-Pacer, which was due to arrive soon.

Beech Experience at Belfast

By FRANK ROBERTSON, *chief engineer, Light Aircraft Division, Short Brothers and Harland Limited*

SINCE becoming distributors for Beechcraft last autumn, the Light Aircraft Division of Short Brothers and Harland, Ltd., has had an opportunity to study fairly closely some of the products of the Beech factory and its findings may be of general interest.

Engineering design

Before asking Beech for the privilege of being allowed to distribute their products we had, of course, been at some pains to establish that the quality of their engineering was of a standard with which we, as prime aircraft manufacturers with a proud record of our own, would want to be associated.

Our experience over the past six months has confirmed our early appraisal. Our Kansas friends do some things differently from us, but they certainly do them well!

We have often been asked the question: "Why do you distribute an American aeroplane? Why don't you design one of your own? After all you are doing the Skyvan yourselves." The answer is very simple. When we did our preliminary design studies we found that, in the light commercial transport field, we could design a machine which would have little serious competition, whereas in the business transport field we simply could not design a machine to be significantly better than the existing American types which had already established a firm and rapidly expanding market.

It may be an unpleasant fact to have to stomach but I believe it nevertheless to be a fact that we in Britain have lost so much ground in the field of business aircraft that our only real hope of getting back into the market is to challenge in the next generation of aircraft and not in the present one. In the meantime, let us learn from the competition.

The three Beech types with which we have so far had experience are the Debonair (Fig. 1), Travelair (Fig. 1) and Queen Air (Fig. 1). These represent a good cross-section of the Beech range as can be seen from Table 1—

TABLE 1

Type	A.U.W.	Power	Seats	Max. speed	Max. (45 min. res.) range
	lb.	h.p.		kts.	n.m.
Debonair	3,000	1×225	4	169	912
Bonanza	3,125	1×260	4	178	1,058
Travelair	4,100	2×180	5	182	1,130
Baron	4,880	2×260	5	200	1,086
Twin-Bonanza ..	6,300	2×295	6/7	186	1,305
Queen Air	7,700	2×340	7/9	208	1,043
Super 18	9,700	2×450	8/11	202	1,378

TABLE 2

Type	Wing load	Power load	Aspect ratio	IFR. wt.,lb.	Eq. wt.÷ A.U.W.%	C_L max.	L/D max.	N_1*	V_D*
	lb./sq. ft.	lb./h.p.							kts.
Debonair ..	16.9	13.4	6.1	1,895	63.1	1.84	10.1	4.4×1.5	217
Travelair ..	20.6	11.4	7.2	2,805	68.3	1.64	13.6	4.4×1.5	235
Queen Air..	27.8	11.3	7.6	5,090	66.1	1.70	12.2	4.4×1.5	260

Basic parameters

Taking the three types already mentioned as examples, let us take a look at the basic design parameters in Table 2.

Before discussing these, the column covering "Equipped weight—IFR -lb" should be explained. What I have done is to take the equipped weight of the basic aircraft, which includes instruments, cabin heating, etc., and added an allowance for nav./comm. equipment and certain extras which I consider to be desirable. These additions over and above the basic weights are:—Debonair + 150 lb., Travelair + 170 lb., Queen Air + 350 lb.

TABLE 3

Type	B.C.A.R.		BEECH	
	N_1	V_D	N_1	V_D
		kts.		kts.
Debonair	3.5×1½	203	4.4×1.5	217
Travelair	3.5×1½	223	4.4×1.5	235
Queen Air	3.46×1½	239	4.4×1.5	260

A study of this table reveals the Beechcraft to be typical American aeroplanes involving no outstanding technical breakthrough. Our transatlantic friends have clearly given us a bit more power than is necessary—a traditional and very pleasing "fault" of U.S. aircraft—and the weights show the usual ⅔-¼ ratio between aeroplane and useful load which one expects to find in light aircraft. The modest values of lift coefficient achieved indicate simple flap systems of moderate area and the lift/drag ratios appear to be capable of development. The factor N_1* shows clearly that Beech have concentrated on making a strong aeroplane.

It is interesting to compare the values of N_1 and V_D used by Beech with corresponding values for these parameters which we would have had to use to clear B.C.A.R. (Table 3).

From a purist aspect, one could criticize Beech for making

(*Continued on page 567*)

* N_1 is the maximum manoeuvring load factor and V_D the design diving speed.

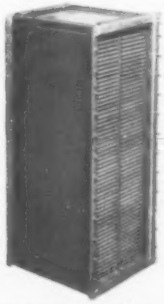
Fig. 1. The three Beech types analysed in this article, the Travelair, Debonair and Queen Air.

HERALD by Handley Page

Wing de-icing heat exchanger

Insulated ducting

by



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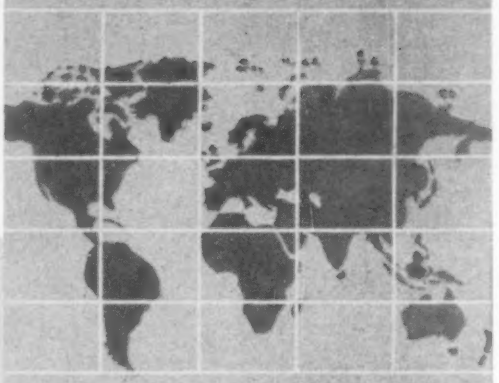

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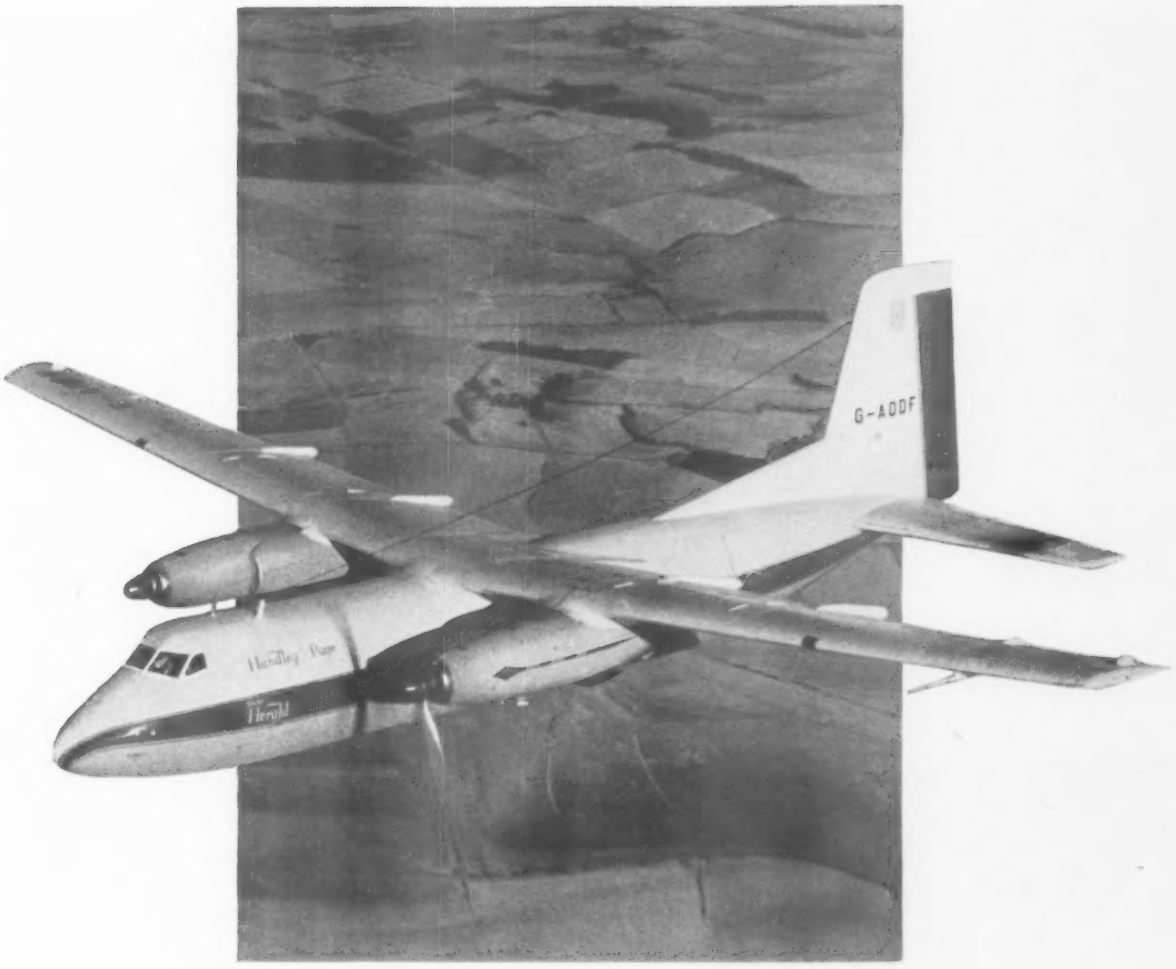

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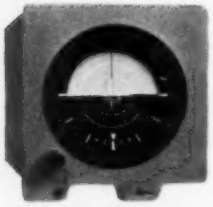
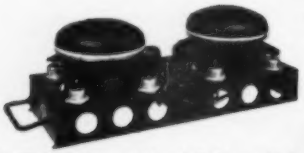


Roller-blind Director/Horizon

Machmeter

Vertical Speed Indicator



Twin CL.11 Rotorace Azimuth Reference Unit

VGL.2 Attitude Reference Unit

Sperry Gyros form the heart of the Trident's attitude display system. CL.11 Rotorace Directional Gyros provide the azimuth references; VGL.2 Vertical Gyros supply precise attitude information to the roller-blind director/horizons designed for de Havilland's new jetliner. Sperry also manufacture the Trident's Air Speed Indicators, Vertical Speed Indicators and Machmeters.

Altogether the Sperry Team is contributing 18 functional instruments to the overall Smiths/Sperry consortium project.

The Trident is one of many important aspects of Sperry's aeronautical work. The company is currently engaged on navigation, guidance, and control problems for VTOL and Helicopters, as well as fixed-wing aircraft: these offer long-term interest to electronic and electro-mechanical engineers and designers, on stable platforms, auto-stabilizers, auto-pilots and instrumentation. If you feel you would like to play a part in

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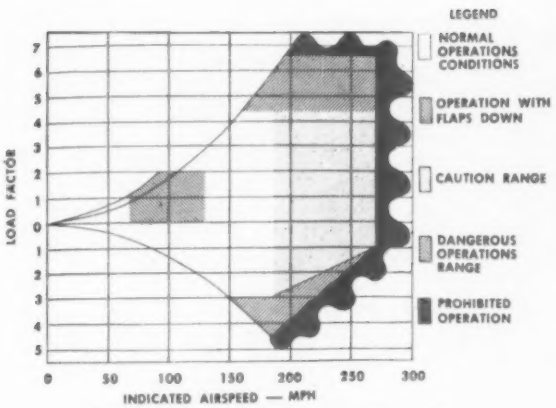

Fig. 2. Flight envelope for the Travelair.

(*Continued from page 566*)

their aircraft stronger than is necessary but, for a range of aircraft intended to be flown by amateur and professional alike, who can think of a nicer fault than being stronger than the "book" says? The fact that Beechcraft are comparable with their competitors on a weight basis speaks well for their detail engineering design, because they have managed to put in quite a lot of excess strength without a significant weight penalty. The structure weight of the Queen Air, for example, is 25% of the A.U.W.

A typical flight envelope, that for the Travelair, is shown in Fig. 2. A study of this diagram should give considerable confidence to any potential user who wants to be able to face all weathers.

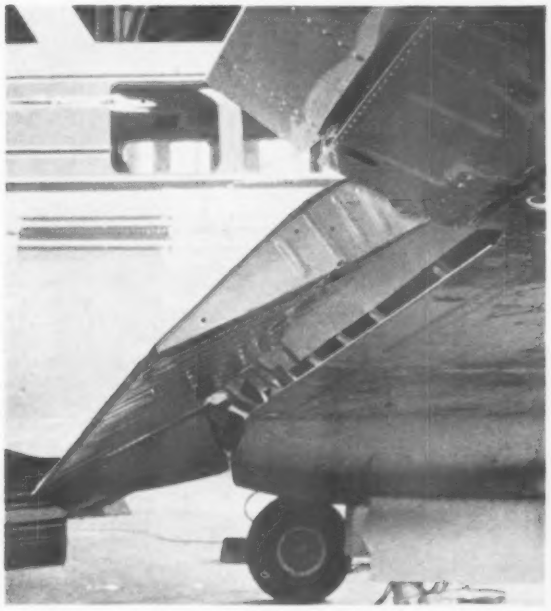

Fig. 4. The slotted flap.

Aerodynamic Design

Certain family features are evident throughout the Beech range. Wing sections are NACA 230 series, varying from 16% to 12% thickness/chord ratio, and a dihedral angle of 7°, high by British standards, is usually present and associated with a "washout" approaching 5°. Beech have thus achieved excellent stalling qualities with a wing-section which, by itself, has a rather bad stall. At the junctions between leading edge and engine nacelle or fuselage, either forward sweep or a sharpened leading edge (or both) have been introduced (Fig. 3).

Flaps are of the single-slotted variety and the slot shape geometry looks as though it is capable of further development (Fig. 4). This opinion is supported by the small flap travel of 30°—it is doubtful if the air flow would adhere at greater angles than this.

Ailerons are of the plain type with internal balances but are not sealed. The lack of aft camber on the NACA 230 wing section makes this possible and produces a crisp, effective roll control.

Tail surfaces have the symmetrical NACA 00 series section and vary in thickness between 12% and 6%. Elevator and rudder are aerodynamically balanced by the aft-set hinge method.

No attempt has apparently been made to achieve laminar flow, and snap-head rivets appear in profusion. On the other hand, a great deal of attention has been paid to avoiding leak drag. Also all the lines are sweet and easy-flowing.

Structural Design

Here again, common features are evident throughout the whole range. Wings are of the conventional two-spar bending beam type, but an unusual feature is the attachment of the skin and rib structures to the main spar booms by means of full span hinge pins.

Control surfaces are almost always made with fluted skin covers and a minimum of internal structure (Fig. 5).

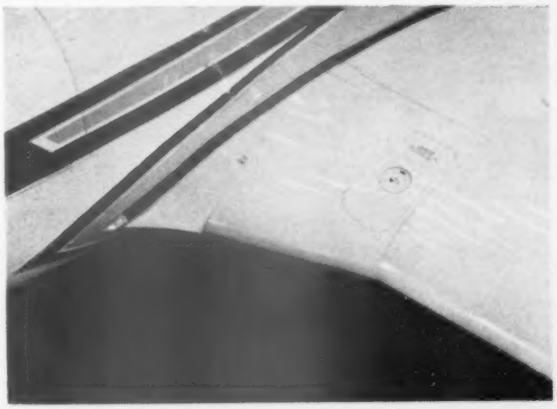

Fig. 3. Good stalling characteristics are ensured by sharpening the leading edge.

Fuselages are semi-monocoque with frames and stringers both riveted to the skins, the former being cut out to allow continuity of the latter.

There is evidence that a large proportion of the structure is made from pressings. There is no sign of anodizing but some parts are internally painted and the outsides of the aeroplanes are very well painted indeed. Special anti-corrosion finish internally is offered to customers for use where climatic conditions are severe.

(*Continued on page 568*)

Fig. 5. Fluted skin covers for control surfaces.

Weight

The three types which have passed through our hands have been carefully weighed and the Beech brochure figure substantiated:—

Debonair: The aircraft is quoted in the Beech owners' manual as having an empty weight of 1,745 lb. EI-ALI, the property of Aircraft Associates, Ltd., was weighed at our Belfast works at 1,827 lb. empty. The difference can be accounted for by the radio installation and one or two optional extras which were fitted.

Travelair: The aircraft is quoted in the Beech owners' manual as having an empty weight of 2,635 lb. G-AREJ, our demonstrator which flew the Atlantic in September last year in the capable hands of Floyd Atchison, of Floair Inc., ferry pilots, was weighed at Belfast at 2,831 lb. The difference between these two weights is satisfactorily accounted for by the nav./comm. equipment and sundry optional extras. This aircraft has VHF/VOR/ILS/ADF.

Queen Air: This aircraft is quoted in the Beech owners' manual as having an empty weight of 4,740 lb. G-ARFF, our demonstrator, which has lavish equipment including toilet, table, de-icing, radar, autopilot, HF, ADF, VHF x 2, VOR x 2, ILS, etc., etc., actually weighs 5,432 lb. and the difference is satisfactorily accounted for by the nav./comm. equipment and various optional extras.

Performance

The Debonair, Travelair and Queen Air have all been flown by Shorts to the limits of the flight envelope and checks have been made on the various performance parameters. Comparison between Beech claimed figures and Shorts observed flight test figures is shown in Table 4.

Corroboration to this degree enables us to pass Beech publicity material straight on to potential customers with our backing.

Throughout the flight test programmes, all pilots concerned were unrestrained in their praise of the general handling. On the ground all the Beech aeroplanes steer easily and do not pitch or roll. Take-off is easy; very little tendency to swing occurs and the aircraft "pop" cleanly off the ground on rotation and get straight on to the business of gaining height fast.

TABLE 4

Condition. *	DEBONAIR		TRAVELAIR		QUEEN AIR	
	Shorts test	Beech manual	Shorts test	Beech manual	Shorts test	Beech manual
Normal climb, ft/min	880	819	960	990	1,473	1,235
Baulked landing climb,	485	488	586	551	1,056	958
Level cruise, kts. ..	160	161	163	163	176	178
Stall, clean, kts. ..	60	60	68	68	78	80
Stall, dirty, kts. ..	51	50	56	59	71	69

* These vary but comparisons have been matched

All the aeroplanes trim out beautifully and can be flown hands off for lengthy periods. Aileron control is particularly good, there being no backlash at all and mighty little friction. Rate of roll is "fighterish" on all types.

Landing is easy and approaches can be made at a wide variety of angles. Once on the ground, Beechcraft stay put firmly and decelerate very rapidly.

The stalling performance deserves special mention; only the single-engined Debonair showed any tendency to drop a wing. Both the twins were gradually slowed down in the dirty condition with idling power and full backward movement of the control wheel was achieved without the aircraft really stalling at all. I quote from the Queen Air flight test:—

"... With flaps and undercarriage down at an A.U.W. of 7,450 lb. and the aircraft trimmed at 112 m.p.h. with both engines at flight-idle power, speed was reduced by approximately 1 m.p.h. sec. and the following characteristics noted:—

(i) Stall warning light and horn operated at 87 m.p.h.

(ii) Very slight airframe buffet occurred at 84 m.p.h.

(iii) Full aft elevator was achieved at 82 m.p.h. and no firm nose-down pitch could be induced."

Conclusions

Those examples of the Beech range which we have so far been able to test and to analyse are well up to the high standards claimed by the makers. They have more power and more structural strength than a mere paper-design would demand and they are sound, safe, "pilots'" aeroplanes.

Technically, they involve conventional aerodynamics and engineering and, whilst admiring them, one cannot help feeling a little disappointed that we in the British aircraft industry did not build them first!

Industry Record

Blowers for Sweden

Several hundred axial-flow blowers have been ordered from Plannair, Ltd., of Leatherhead, by L. M. Ericsson of Sweden. This is a repeat of an order placed last November for the company's air-movement equipment. The blowers are to be used for the temperature control of airfield ground control equipment. Weighing as little as six ounces and having a tip blade diameter of only 1.3758 in., they operate in a wide temperature range at 20,000 r.p.m. from 115-V., single-phase, 400 c/s power supply.

Represented at Moscow

As might have been expected, a number of British companies with aeronautical connections will be represented at the British Trade Fair which opens in Moscow tomorrow, May 19. Among these are the Dunlop Rubber Co., Ltd., Standard Telephones and Cables, Ltd., Ultra Electronics, Ltd., and Pye Telecommunications, Ltd.

A complete tyre and wheel assembly for the VC10 will be a feature of the Dunlop Aviation Division stand. This assembly incorporates a brake installation, Maxaret anti-skid unit and a fan-cooling device for the brake. Also, as an example of its wide range of de-icing equipment, Dunlop will show a Rolls-Royce Tyne turboprop air intake fitted with one of its thermal de-icer overshoes.

Included in the exhibits illustrating Standard Telephones and Cables' many and varied activities in the telecommunications and electronics fields will be the company's current range of airborne equipment. This comprises airborne long- and short-range radio communication sets, airborne landing aids and navigation aids. Two types of radio altimeter will be shown: one for general-purpose height finding up to 1,500 m, and another for use in automatic landing systems. The PVT-2 automatic triangulation equipment for radio direction finding, intended primarily for use as an aid in air traffic control, will be depicted on film.

More than 25 countries now use SARAH—the search, rescue and homing equipment for the accurate location of crew members of crashed aircraft—so quite naturally it figures prominently on the stand of its makers, Ultra Electronics, Ltd. This company is also showing an engine condition analyser and vibration indicator and turbine speed and jet-pipe temperature control amplifiers.

The Pye Telecommunications instrument landing system is nothing new to the Russians since it is installed at Moscow's Vnukovo and Scheremietievo airports. Nevertheless it will be shown alongside other exhibits of the many member companies of the Pye Group. To date some 150 Pye ILS installations have been made in the U.K. and abroad.

Standby Navaid

With the coverage of weather stations and LF directional beacons as well as normal broadcasting stations, the Navigator portable transistor set, a product of the Zenith Radio Corpn., of the U.S.A., can be used to provide standby navigation facilities for private pilots and yachtsmen.

It is an eight-transistor set with 500 mW. of undistorted output and covers the 150-400 and 550-1,600 kc/s bands. Small torch batteries give it a working life, it is claimed, of more than 300 hr. It weighs only 5 lb. Fitted with a navigation/normal control, the Navigator has an easily read azimuth for taking cross bearings and precision Vernier tuning on the main control. Cost in this country—through the United Mercantile Co., Ltd., Sovereign House, Queen Street, Mayfair, London, W.1, the U.K. Zenith agents—is £69 6s. 11d.

Spares Agents

With the exception of direct sales to B.O.A.C. and B.E.A., the Babb Company, a division of International Aircraft Services, Inc., is to act as agents for the sales of all Air France surplus Viscount, DC-4 and Constellation spares. This organization has its offices at B.P. 105, Aéroport d'Orly (Seine), France. In the U.K. it is represented by Mr. P. T. Griffith, managing director of the Babb Company (Britain), Ltd., whose address is 188 Brompton Road, London, S.W.3.

Mobile Air Distribution

Realizing the need for a single unit able to perform all the air pressure servicing functions required by present-day aircraft, I.V. Pressure Controllers, Ltd., of Isleworth, has produced, in collaboration with B.E.A., a mobile air distribution panel. This has been built in a light-alloy case mounted on a two-wheeled tubular chassis and is manœuvrable by a single operator.

Built for maximum inlet pressure of 4,000 p.s.i., one side of the unit is for tyre inflation and the other is devoted to general servicing. This includes the pressurizing of pressure accumulators and oleo legs and a low-pressure supply for tyre inflation from 5 p.s.i. to 250 p.s.i. A high-pressure line handles requirements between 500 and 3,500 p.s.i. A 60-ft. hose is provided for coupling to a high-pressure source. A main pressure gauge in the input panel registers all flows to the unit and incoming air is diverted to either of the two servicing panels by isolating stop valves.

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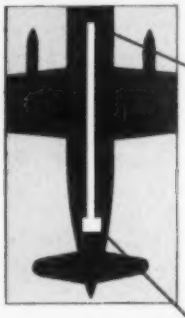

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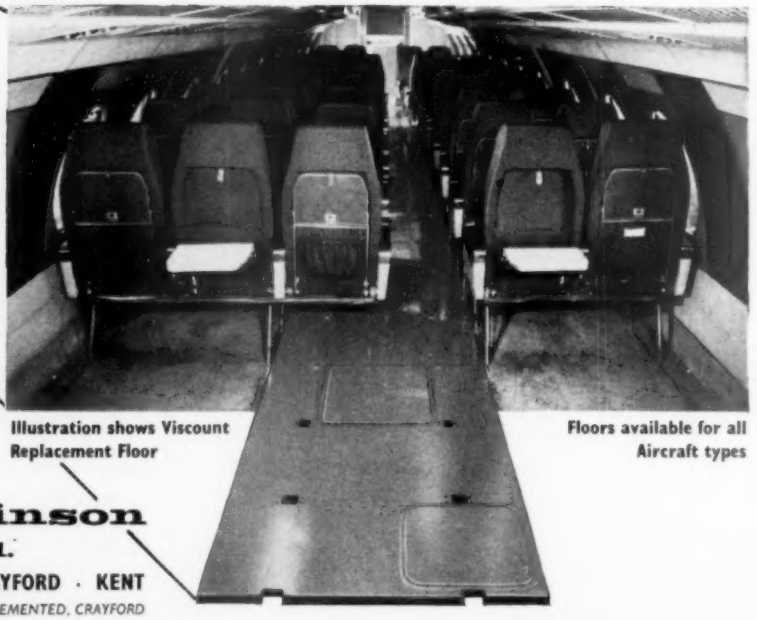

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Correspondence

Anti-g Suits

WE wish to refer to your editorial comment which forms the postscript to a letter by Lt. Col. O. Gronmark (R.N.A.F.) headed "G" Suits and Immersion Suits, on Apr. 27.

We should like to point out that both R.A.F. and Fleet Air Arm pilots have for the past five years or more been able to wear anti-g suits with immersion suits.

A special seal is manufactured which, fitted by the Services themselves to the immersion suit, allows the anti-g suit hose to pass through without leakage.

Manchester, 10. W. OLDHAM,
Development Manager,
P. Frankenstein and Sons (Manchester), Ltd.

X-15 Speed Correction

REFERRING to your account of the latest speed achievement of the North American X-15 research aircraft on Apr. 21, reported in THE AEROPLANE AND ASTRONAUTICS, Apr. 27, p. 448, may I submit for the published record the corrected instrumentation figures now checked and confirmed by the NASA.

The initially quoted speed of 3,140 m.p.h. now stands corrected to 3,074 m.p.h. (Mach 4.62) and it was achieved at full thrust at a height of 79,000 ft. The peak altitude attained was higher than at first announced, namely 105,100 ft. in place of 103,000 ft. A maximum air friction temperature of 657° F. was recorded at the lower vertical tail. Despite an unscheduled drop of some 7,000 ft. upon release from the B-52 carrier before his rocket engine ignited, and some trouble with the cabin pressurization at 90,000 ft., the pilot, Maj. Robt. White, U.S.A.F., laconically described the mission as "routine."

A background note on why this kind of correction has become exasperatingly prevalent is called for. In order to gratify the thirst of the news media in America, it is NASA publicity policy at Edwards Flight Test Centre to announce to the World—doubtless with an eye cocked towards the Eastern half—a preliminary set of figures before the instrumentation data have been fully and finally analysed. A day or so later the corrected figures become available—for those who care to re-search them for the record. But, for the ordinary newsman, there is nothing "deader" than yesterday's warmed-over news—especially if the cooking kills off some of the calories!

In view of the well-planned, well-executed research, engineering, instrumentation and flight test techniques for which the NASA are rightly world-famous, the engineer and scientist—and the recording angel, the technical journalist—must regret the intrusion of the Press agent, with his ephemeral hot news flash, into this kind of serious research work. This is just one more illustration where white-hot news would be more accurate, if not quite so optimistic, after a little cooling off.

Santa Monica, Calif., U.S.A. STANLEY H. EVANS.

[The NASA correction of the X-15's speed to 3,074 m.p.h. was recorded in our May 4 issue.—ED.]

"Graduates for Maintenance"

YOUR recent editorial (Apr. 13) of this title spotlights a problem which has been of concern to The Society of Licensed Aircraft Engineers for the past decade.

Almost every airline employs a number of graduate engineers in their development branches, where the work is comparable to that of the development staffs of the manufacturers. However, the production (or maintenance) side of airline engineering organizations believes practical experience to be of paramount importance. Although men of the innate intelligence and thinking ability represented by the graduate are needed in the field of maintenance, it is very difficult to see many graduates spending the years of "graunching" (at lower pay than they would receive elsewhere) which are necessary to give them the practical experience needed for the safe and economic management and supervision of airline engineering.

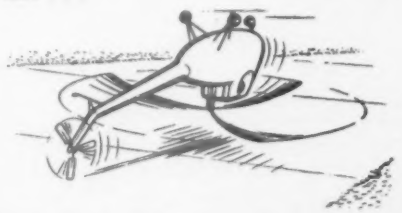
In the past, most service and civilian apprentice intakes included a reasonable proportion of young men of high potential who, having gained their education and experience "the hard way," now manage many of the World's airline engineering organizations. However this source is tending to dry up because public education now provides more and more university and full-time technical college places, which have more social prestige in the eyes of most young men than apprenticeships.

Some 12 years ago the S.L.A.E. undertook an extensive investigation into the nature of the airline engineer's tasks, his necessary educational attributes and his qualifications. It was found that the breadth, and not the depth, of his knowledge of science, engineering, mathematics and legislation posed his

Wroundabout Ten. Ten years ago today, the world of aeronautical literature stood aghast—the first Wroundabout column appeared. My ego, which sees to it that a record is kept of our impressive achievements, tells me that this is item No. 2,140 in column No. 429, and that during Wroundabout's lifetime I have flown three times round the World and can make the quite useless claim to be the World's highest (45,000 ft.), fastest (Mach. 1.02) and farthest (Paris-Alaska, 4,685 mls.) columnist. The F.A.I. have confirmed that these figures are unequalled by any other aviation columnist named Wren. As this feature has been kept going largely by the friendly help of readers all over the globe who like to share their enjoyment of this wonderful mad business of aviation, Wroundabout is really *your* column, so—many happy wreturns!

*

Decade Parade. The people featured in that first column—Alan Bristow, "Willie" Wilson, Leonard Bridgman and Geoffrey Tyson—are still in aviation's thrall, but I wonder what happened to W.R.A.F. Sgt. Peggy Duncan and her horse? Geoffrey Tyson, now with Dunlop's aviation division, was then Saro's chief test pilot and people were still remembering his inverted flying of the SR/A1 jet fighter flying boat at the S.B.A.C.'s 1948 Display. Because Saro had just taken over Cierva's, I forecast that we might see, at the 1951 Display, a bit of Skeetery going something like this. . . .



Pussy's in the Well.—From Wren-line to feline. B.E.A.'s aircrew journal *Intercom* prints a glorious report concerning a cat which popped out of a Comet's wheel-well during turn-round checks at Frankfurt. *Problem*: Did it get in at London? Their LAP Engineering Supt. points out that the area of occupation was "unpressurised, uncomfortable and unlikely . . . survival impossible, even with the allotted nine lives." However, for the sake of a racy rhyme headed "Cool for Cats" a B.E.A. doctor assumes that pussy *did* fly. It starts: "This is the tale of 'Catellite,' B.E.A.'s first satellite" and includes the moving passage:—

"She found herself, chocks all in place,
Staring at strangers face to face,
Who coaxed her in a guttural tongue
And started frisking her for young
(As if a cat of her refinement
Would choose a wheel for her confinement!)"

I'd say it was a clear case of catasterism—from the Greek *katasterismos*, you know—the act of placing among the stars.

by Wren

Correspondence . . . .

educational problems. Existing qualifications at top level were almost entirely absent, including degrees, the corporate membership examinations of the older learned societies and H.N.C.

Accordingly, the S.L.A.E. set about a triple programme to provide attainable targets for various types of man entering the profession.

For the craftsman, tradesman and technician, the S.L.A.E. has helped to initiate and develop the various City and Guilds courses in aircraft maintenance engineering in such form that they are teachable by conventional practices in most day-release and evening class technical colleges.

Secondly, the S.L.A.E. has done a great deal in conjunction with the Air Registration Board and the Ministry of Aviation to strengthen the position of licence holders, to adjust the form of the licence examination to contemporary circumstances and to encourage more engineers to obtain this qualification. Although not necessarily always a suitable yardstick for the selection of the future hierarchy of airline engineering, the licence continues to be the most important safeguard to the safety and reliability of airliners. This is because it places responsibility firmly upon engineers of proven capability and knowledge. This is very important in a rapidly changing technology when each successive generation of aircraft tends to be built of new materials, to embody new principles and to have new varieties of "nerves, systems and controls."

Thirdly, under a central examining authority the S.L.A.E. established in 1953 a unique form of syllabus and examination to govern entry to the Society's Associate Membership grade. With the present managerial and executive aircraft engineers setting and maintaining the standards which they expect of their own top quality employees, the A.M.S.L.A.E. qualification has been extremely successful in proving a man's capacity for intermediate management with, most important, proven capacity to achieve promotion to higher grades. There is now no doubt that the next but one generation of airline technical directors, chief engineers and chief inspectors, manufacturer's service managers and senior aircraft engineering officers in H.M. services will come from the ranks of the men who have been successful in the A.M.S.L.A.E. examinations.

How is one to train "graduate-calibre" engineers for airline engineering?

The answer must lie with the airlines themselves. They are the only people with the necessary training facilities, i.e., complete modern maintenance and overhaul bases handling large complex aircraft. Although the editorial mentioned trade union barriers as possible obstacles to extended training within the airlines, it should be remembered that in a good cause the trade unions will co-operate.

Despite the swing of education to increased numbers of places at universities and technical colleges, the airlines must make every effort to attract into their engineering apprenticeships (over and above their more widely based intake of craft and trade apprentices) a smaller stream of boys from the public and grammar schools and the "A" streams of secondary technical schools. At the moment, these engineering apprenticeships lead through City and Guilds' certificates and H.N.C. to licences and the A.M.S.L.A.E. qualification. Of these stages all except one, namely H.N.C., are relevant to the profession.

The Higher National Certificate unfortunately involves the learning of subject matter largely useless in airline maintenance except for the gaining of that particular academic qualification. The H.N.C. is regarded as the only general educational yardstick available which does not waste too much of the apprentices' time on non-essentials.

How much more sensible it would be if it were to be replaced by a Dip. Tech. in Airline Engineering based upon those parts of the A.M.S.L.A.E. syllabus which are amenable to sandwich teaching? Such a Diploma would give the aircraft engineer a qualification recognized and understood nationally as beyond the confines of the profession itself, directly comparable in status and standard to other engineering professions and which, when combined with the necessary experience, would lead him naturally to the unique professional qualifications required in airline management.

Maidenhead, Berks. PETER F. MURRAY,
General Secretary,
The Society of Licensed Aircraft Engineers.

Publications Received

Learning Morse, by H. F. Smith. A concise guide to methods of learning, key manipulation and practice. Includes the revised Q code which comes into use this year, but not the QAA—QNC group reserved for the aeronautical service. 20 pp., 5 in. by 7¼ in., illustrated. Iliffe Books, Ltd. 1s. 6d.

Full Scale Fatigue Testing of Aircraft Structures, edited by F. J. Plantema and J. Schijve. Comprises all the papers presented at the international symposium on aircraft fatigue testing held in Amsterdam in June, 1959, and a summary of the ensuing discussions. 426 pp., 6 in. by 9 in., illustrated. Pergamon Press. £5.

War Planes of the Second World War, Fighters, Vol. II, by William Green. This is the second of a series of volumes which, when complete, will provide for the first time a complete and authoritative survey of all the aircraft used operationally by the combatant Powers in World War II. This volume, the second of four to be devoted to fighters, covers the aircraft of Great Britain and Italy; the format is similar to the first but the paper has been improved with advantage to the quality of reproduction of the photographs, of which there are 220 in addition to 66 three- or four-view line drawings. 192 pp. 5½ in by 4¾ in. Illustrated. Macdonald and Co. (Publishers), Ltd. 9s. 6d.

Aviation Calendar

May 18

London.—R.Ae.S. Astronautics and Guided Flight Section lecture, "The Agena Satellite and the Discoverer Programme," by R. Smelt, in the Lecture Theatre, 4 Hamilton Place, W.1, at 18.00 hrs.

May 20

Fréjus.—Fréjus-St. Raphaël Aero Club Rally; until May 22.

May 22

Hucknall.—Air Display organized by R.A.F.A.

North Weald.—Air Display organized by R.A.F.A.

Yeadon.—International Air Pageant organized by S.S.A.F.A.

May 27

Liège-Bierset.—Royal Belgium Aero Club and ANCUPA Rally; until May 28.

May 31

Le Bourget.—International Grand Prix for Helicopters of the French Aero Club.

Company Notices

NEW COMPANIES

Air Universal, Ltd. (690,191).—Private co. Reg. Apr. 19. Cap. £100 in 5s. shrs. To carry on the business of travel agents, aviation consultants, sale and purchase of aircraft, chartering brokers. Directors: Mrs. Phyllis K. Harrison and Mrs. Florence S. Bishop, both of 11A East Street, Brighton. Sec.: Phyllis K. Harrison. Reg. off.: 54 Ship Street, Brighton.

Bureau of Aviation Statistics, Ltd. (690,112).—Private co. Reg. Apr. 18. Cap. £100 in £1 shrs. Directors: Richard G. Worcester and Inge Worcester, both of Sussex House, Parkside, S.W.19. Sec.: Inge Worcester. Reg. off.: 13-14 Great Castle Street, W.1.

Contract and General Aviation, Ltd. (690,913).—Private co. Reg. Apr. 27. Cap. £100 in £1 shrs. To provide advisory, consultative and other services to the aviation industry. Directors: Maurice H. Curtis, Gilcroft, Checkendon, Oxon; Leslie B. Greenwood, Pier Cottage, Milland, Liphook. Sec.: M. H. Curtis. Sols.: Neish Howell and Haldane, E.C.4. Reg. off.: 278-282 High Holborn, W.C.1.

New Patents

APPLICATIONS ACCEPTED

870,689.—**W. Czerwinski.**—"Aircraft control surface actuating mechanism." May 21, 1959. (May 26, 1958.)

870,686.—**E. Leiber.**—"Transport aircraft." May 1, 1959.

870,182.—**United Aircraft Corporation.**—"Air inlet for high speed aircraft.—Sept. 24, 1958. (Dec. 23, 1957.)

870,629.—**J. Martin.**—"Parachute apparatus." Feb. 5, 1959. (Feb. 10, 1958.)

870,587.—**General Motors Corporation.**—"Thrust spoiler for a jet propulsion engine." Nov. 27, 1959. (Nov. 28, 1958.)

Printed specifications of the above will be available on Jne. 14, 1961, and the opposition period will expire on Sept. 14, 1961.

871,089.—**Aero Controls, Ltd.**—"Device for the suspension and release of objects from aircraft." Apr. 14, 1960. (Apr. 24, 1959.)

870,917.—**Microcell, Ltd., and M. Bingham.**—"Cooling aircraft or component parts thereof." Oct. 13, 1958. (Oct. 11, 1957.)

871,050.—**Hiller Aircraft Corporation.**—"Rotary wing aircraft." Jan. 1, 1959. (Jan. 17, 1958.)

871,257.—**R. E. Jackson.**—"Helicopter aircraft." May 1, 1958. (Oct. 15, 1957.)

871,267.—**Kaman Aircraft Corporation.**—"Helicopter rotor correction mechanism." Jne. 19, 1959.

870,739.—**Vickers Aircraft Holdings, Ltd.**—"Aeroplanes." Nov. 3, 1959. (Oct. 30, 1958.)

870,872.—**Rolls-Royce, Ltd.**—"Gas turbine engines." Nov. 18, 1959. (Nov. 26, 1958.)

871,060.—**Fairey Co., Ltd.**—"Helicopter undercarriages." Sept. 2, 1959. (Sept. 8, 1958.)

871,038.—**Westinghouse Electric Corporation.**—"Aviation jet propulsion engines." Oct. 7, 1959.

Printed specifications of the above will be available on Jne. 21, 1961, and the opposition period will expire on Sept. 21, 1961.

Personal Notices

BIRTHS

Ambrose.—On Apr. 19, in Belgrade, to Jean, wife of Gp. Capt. C. F. Ambrose—a son.

Baney.—On May 2, at Bath, to Maud (*née* Arnot), wife of Flg. Off. T. H. Baney—a daughter.

Barter.—On Apr. 21, at Queen Charlotte's Hospital, to Patricia, wife of Wg. Cdr. F. C. Barter—a son.

Brambley.—On May 1, at Moreton-in-Marsh, to Sheila (*née* Child), wife of Flt. Lt. F. R. Brambley—a son.

Douglas.—On May 8, in Cyprus, to Joy (*née* West), wife of Sqn. Ldr. J. Douglas—a son.

Fox.—On May 4, at York, to Sally, wife of Flt. Lt. R. Fox—a son.

Geffryes.—On Apr. 23, in Singapore, to Maureen (*née* Snaith), wife of Flt. Lt. S. D. Geffryes—a daughter.

Glover.—On May 4, at R.A.F. Hospital, Ely, to Joan (*née* Parkinson), wife of Flt. Lt. R. W. Glover—a son.

Livermore.—On Apr. 26, at Cambridge, to Anne (*née* Bellman), wife of Flt. Lt. R. Livermore—a son.

MacDonald.—On May 4, at R.A.F. Hospital, Wegberg, to Sylvia (*née* Lees), wife of Flg. Off. J. MacDonald—a daughter.

Milne.—On Apr. 29, at Woodford Green, to Sheila, wife of Sqn. Ldr. W. C. Milne—a son.

Ramage.—On May 9, at Farnborough Hospital, to Martine (*née* Chown), wife of Peter Ramage of THE AEROPLANE AND ASTRONAUTICS—a son.

Stanton.—On May 5, at the B.M.H., Singapore, to Shirley, wife of Flt. Lt. J. R. Stanton—a daughter.

Thomas.—On May 3, at Emsworth, to Jennifer (*née* Clarke), wife of Flt. Lt. R. G. Thomas—a son.

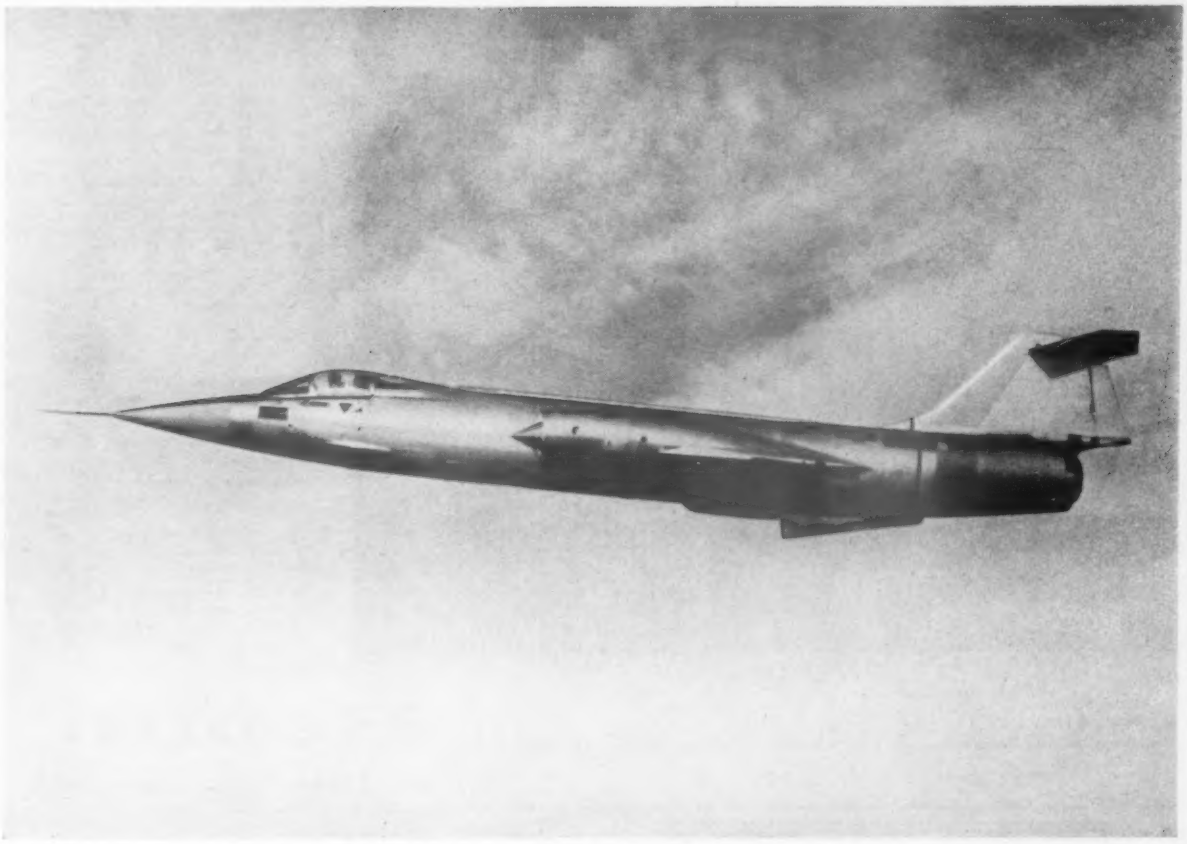
Toull.—On May 1, at Bedford General Hospital, to Jenny (*née* Olding), wife of Flt. Lt. G. R. Toull—a daughter.

DEATHS

Edwards.—On Apr. 26, the Rev. Maurice Henry Edwards, O.B.E., formerly Chaplain in Chief, R.A.F.

Gobey.—On Apr. 26, Flt. Lt. A. J. Gobey.

Mayes.—On May 4, Gp. Capt. Walter Robert Mayes, O.B.E., D.S.M., A.F.M., R.A.F. (retd.).



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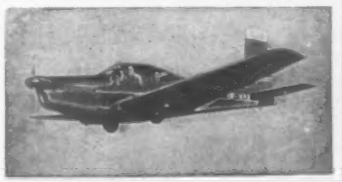

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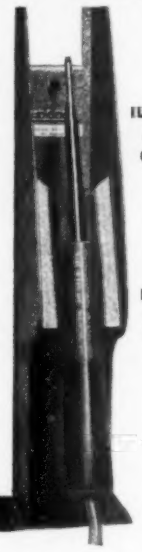

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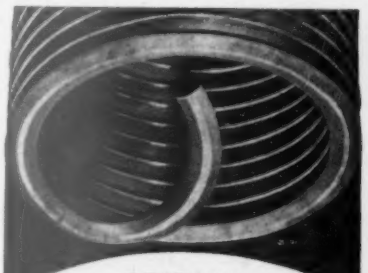

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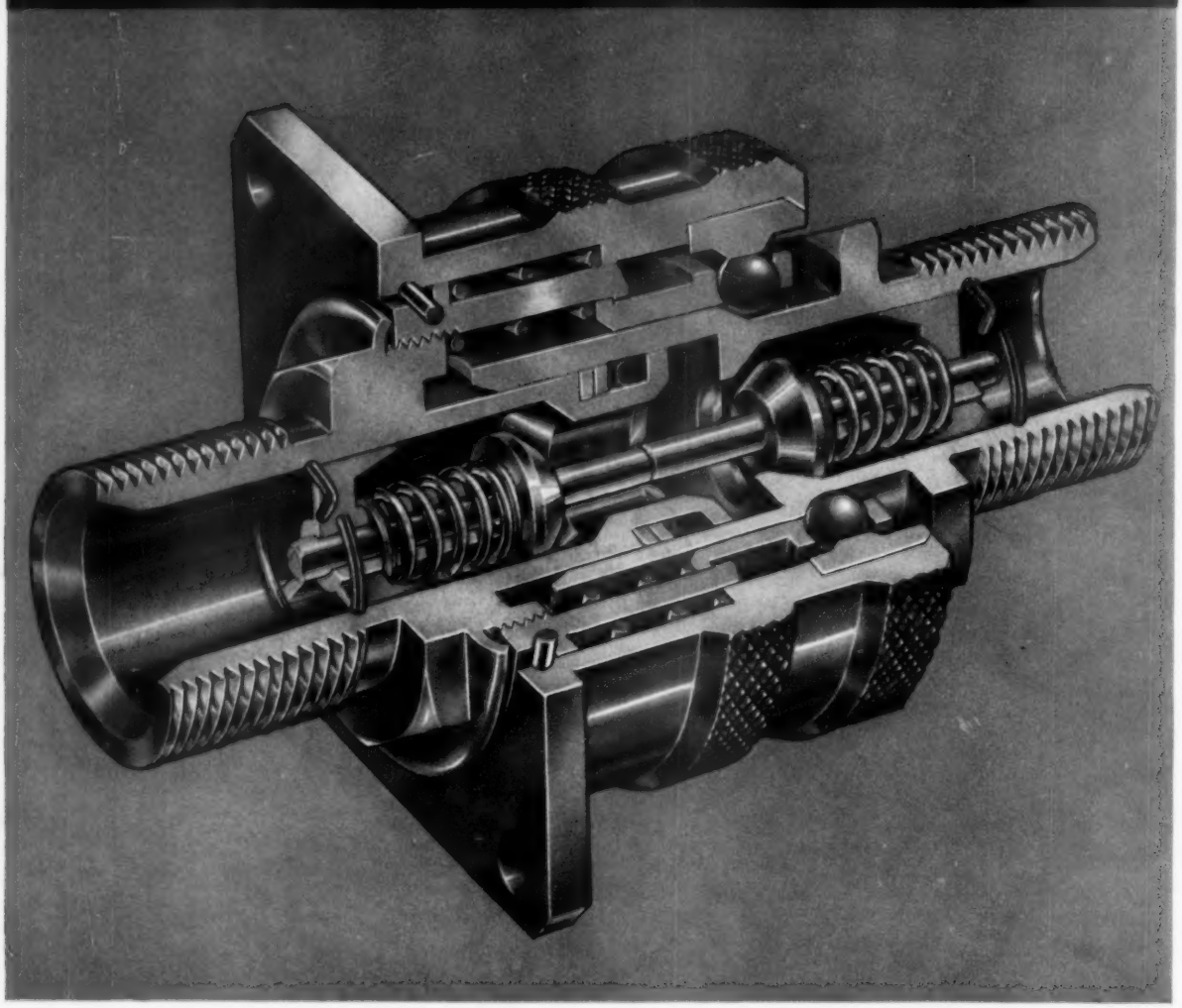

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